FOREWORD

Education Sector Reform Assistance (ESRA) program is an initiative funded by the United States Agency for International Development (USAID) in support of the Government of Pakistan's Education Sector Reform (ESR) efforts. USAID/ESRA focuses on five key technical areas (policy and planning, professional development, adult and youth literacy, public-community/public-private partnership and information and communication technologies for education) and operates in 12 districts of Sindh and Balochistan and the Islamabad Capital Territory in over 11,000 primary schools and works with more than 30,000 teachers.

Professional Development (PD) program of USAID/ESRA is working to develop a sustainable Professional Development Infrastructure (PDI) for the government at various levels. In collaboration with local institutions and experts, PD has developed training manuals and guidebooks for teachers, head teachers and managers over the past three years and used them for training programs. This manual is part of a series of eight manuals developed to enhance professional capacity of teacher educators, and has been written by experts working in various national public and private sector institutions (see acknowledgements list for authors and institutions).

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USAID/ESRA Professional Development Team
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CONTENTS

TECHNIQUES FOR INSTRUCTION AND ASSESSMENT IN MATHEMATICS

Foreword		I
Acknowledgements		II
Purpose of the Documents		1
Demonstration Lesson # 1	Addition	6
Demonstration Lesson # 2	Multiplication	11
Demonstration Lesson # 3	Even and Odd Numbers	16
Demonstration Lesson # 4	Fraction, Decimal Fraction, Tenth Hundredth	23
Demonstration Lesson # 5	Addition up to 3 digits	30
Demonstration Lesson # 6	Highest Common Factor	34
Demonstration Lesson # 7	Triangle	38
Demonstration Lesson # 8	Prime Factor	43
Demonstration Lesson # 9	Area of Rectangle	48
Notes to the Facilitator		55
Feedback Sheet for Demonstration		56
Glossary		57

PURPOSE OF THE DOCUMENT

Introduction

This module contains teaching techniques and strategies that will support lessons in current textbooks at government schools, and will draw on principles of reflective practice and constructivist models of teaching. These techniques and strategies are designed to encourage students to become more active and independent learners.

Teachers have many topics to cover in teaching mathematics in the primary grades. They must teach numbers, geometry, measurement, and many others. It is not possible to cover all mathematics topics in this module. It is the purpose of this module to introduce teachers to a *way* of teaching mathematics that they can use with many mathematics topics. This way of teaching, called **constructivism**, will be shown with the demonstration lessons in this module. The demonstration lessons will include the following topics: simple addition, basic geometry shapes, and highest common factors.

Framework of Learning

This module is based on constructivist ideas about how students learn. When we lecture to children from a textbook, they are passive learners. For some lessons and topics this is appropriate, but for most lessons and topics, teachers can use constructivist strategies to activate students' curiosity, ask students to share what they think, and engage students so that they become active learners.

Constructivist ideas suggest that students learn best when teachers first help them **activate background knowledge** about a topic, then support them **construct meaning** from new knowledge or a new skill, and finally teach them to **evaluate and apply** what they have learned in the lesson. The lessons in this module are based on these three phases of a teaching session or unit.

PHASE I: Activate Background Knowledge	**PHASE II: Construct Meaning**	**PHASE III: Evaluate and Apply**
During this phase of the lesson, the teacher helps students recall knowledge that they may relate to the new topic.	During this phase of the lesson, the teacher presents activities that introduce new knowledge or skills and help students discover what the knowledge or skills mean to them.	During this phase of the lesson, the teacher helps students think deeply about what they have learned and how to apply what they have just learned to new situations or to further learning.

PHASE I: Activate Background Knowledge

In this phase, techniques are used to remind the students of the knowledge they already have on the topic and to encourage students to develop a real purpose for learning new information. It is also possible to show the students how mathematics is connected to their own lives and the knowledge they use every day. For example, Mrs. Badar might ask Sajida how many brothers she has and how many sisters she has. When Sajida says she has two brothers and one sister, Mrs. Badar might use marks on the board to show that this means Sajida has three siblings. This phase is an opportunity to motivate the students to be actively involved in learning new information.

PHASE II: Construct Meaning

In this phase, the teacher engages the students in constructing meaning from new knowledge or skills presented in this lesson. Teachers encourage and support students as they find answers to questions in textbooks, questions from the teacher, and finally, as they learn to answer their own questions.

PHASE III: Evaluate and Apply

This phase includes techniques that help the teacher and the student work together to evaluate the learning that has taken place. The strategies help the students to remember and reorganize important information, ideas, and their relationships that they have learned from the lesson. This phase is enhanced if the teacher can help students connect what they have learned to their daily lives and reflect on their learning. In this phase, the teacher should also help students monitor their own learning and give students feedback on their learning.

Methodologies in each phase:

Following methodologies have been recommended for various sessions. These are: brainstorming, group work, pair and share, individual reading followed by questions, role play and case studies.

In this module, generally instructions for the trainer are given with the exercises. However, a few tips for brainstorming and small group work may be remembered as they are most frequently used methods.

The Purpose of Brainstorming:

The Brainstorming technique can be used in a variety of settings and is essentially a way to facilitate creative group thinking and decision making.

For conducting brainstorming sessions, the facilitator needs good leadership qualities. S/he must be very firm in ensuring that the format and ground rules are followed (e.g., no criticism or cross talk is allowed). In the case of decision making, the Facilitator should ensure that the decisions are seen to be that of the group, not imposed upon them by the facilitator.

Requirements:

- Clearly stated question, issue or problem.
- A group with potential to work as a team.
- A board, large sheets of newsprint, or something that can be seen easily by all, and some thick markers to write on it; and
- A facilitator. Someone whose task is to draw out the ideas from the participants, not to impose her or his own opinions, while still using leadership skills to maintain the order and purpose of the session.

The Ground Rules:

- The facilitator leads the session. However, the facilitator can choose a participant to note down the points on the white board/flipchart.
- The facilitator calls for ideas/ suggestions from the participants and writes them on the board;
- No criticism of anyone's suggestions/responses should be allowed;
- All suggestions should be recorded on the board (even the crazy ones);
- The pace must be quick. As soon as ideas seem to be drying out, the activity should be ended.
- Finally, the ideas must be categorized to put them in 'groups of similar concepts,' so that the irrelevant/crazy ones can be left out of the discussion that follows the brainstorming activity.

Small Group Exercise:

Group discussions or exercises are activities in which participants share information, experiences, knowledge, opinions, and / or ideas. It is important that the facilitator should clearly define the task through clear instructions, and the expected outcome from the group exercise. The exact time available to the group should also be conveyed. The time limit should be strictly followed to finish the modules on time. If the task is written on the board or the flip chart, the chances of ambiguity and misinterpretation are reduced.

Finally, the ideas must be categorized to put them in 'groups of similar concepts', so that the irrelevant/crazy ones can be left out of the discussion that follows the brainstorming activity.

Strengths of Small Group Exercises:

Please remember that small group techniques are used as they:

- emphasize active participation and interaction;
- are usually run by a group leader or facilitator;

- have a task, theme, or goal;
- help reach consensus or develop priorities;
- gather a range of ideas, opinions, and concerns; and
- allow the reporters to report back to the larger group, after discussion.

The Facilitator should emphasise that the group is expected to select a leader who will ensure that all the participants contribute in the discussion, no one person dominates the thinking, the time limits are observed, and the objectives of the group task are achieved.

The facilitator should go around when the groups are working/discussing something. However, the role of the facilitator is not "policing" to just walk up and down as a supervisor. The facilitator should quietly listen to what the groups are discussing, and he/she can clarify a point or give his/her own opinion on the topic, if needed.

Apart from the group leader, a member is selected as the reporter or writer and another person keeps the time. The member nominated as writer or reporter within the group notes down the points of the discussion. At the end of the discussion the group opinion is to be put on a sheet for presentation. The group decides about the presenter.

Why is Teaching Mathematics generally important?

Mathematics is the science of measuring. It uses numbers and shapes. Mathematics includes such topics as addition, subtraction, multiplication, and division. It also includes geometry, in which we study shapes like triangles and circles, and calculate such formulas as the area of a rectangle.

Constructivism is a good way to teach mathematics. Children are naturally curious about the world around them. There are numbers and shapes everywhere in the world, so there are many ways to show students how to practice mathematics in their daily lives. Through constructivist learning activities in mathematics, students can learn mathematics and can develop good attitudes about mathematics.

Constructivist learning activities in mathematics:

- Allow students to monitor their own learning;
- Help students see the purpose for learning mathematics;
- Often draw upon objects and situations in students' daily lives;
- Encourage students to be creative and curious;
- Build upon students' background knowledge;
- Are active, so that students do activities rather than just answering questions from the textbook;
- Ask students to take risks and try new things; and
- Give opportunities for sharing, discussion, and reflection.

Objectives of the Module

Participants should complete the module with the following outcomes:

- Demonstrate understanding of techniques and strategies thorough planning and teaching mathematics lessons;
- Demonstrate understanding of techniques and strategies through planning and teaching maths lessons; and
- Show a responsible attitude towards his/her learning and his/her students' learning.

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Identify Single digit numbers.
- Find the number bonds for 20.
- Understand that the concept of numbers can be understood in a variety of ways.

Class: II

Subject: Mathematics

Topic: Addition

Key words:

Plus, +,

Time frame:

45 minutes

Demonstration Lesson # 1
Sindh Text Book Board, Book 2

PHASE 1	**ACTIVATING BACKGROUND KNOWLEDGE**
Time:	7 minutes
Techniques:	Think-pair-share, whole class discussion
Resources:	Buttons
Directions:	Step 1: The teacher will write some single digit numbers on the board (for example, 9, 7, 6, 5) and ask students to read them aloud. Step 2: He/she will divide the class in five groups and give 20 buttons to each group. Step 3: Learners will be asked to count the buttons and note down in their note books

PHASE 2	**CONSTRUCTING MEANING**
Time:	20 minutes
Techniques:	Think-pair-share, hands on activity, small group discussion,
Resources:	Buttons, used calendar/sheet of papers
Directions:	Step 1: The teacher will ask learners to put all buttons into two piles. Step 2: He/she will ask students to describe their piles of buttons as a number sentence, for example 'nine and eleven makes twenty' or 9 + 11 = 20. At this point the teacher will explain the meaning of + sign. Step 3: He/she will ask each group to note down all the different number sentences they can observe. Step 4: He/she will distribute a different number of buttons to each group, for example group 'A' gets 14, 'B' gets 17 or D gets 15. Step 5: He/she asks the students to do step 1 again. He/she will also tell them to list all their observations on sheets of paper given to them.

PHASE 3	EVALUATING AND APPLYING
Time:	18 minutes
Techniques:	Individual work, small group, drawing
Resources:	Colour pencils
Directions:	Step 1: Students will be encouraged to present their observation in front of the class and get feedback from their teacher and other groups. The teacher will also hang their charts on the classroom wall. Step 2: The teacher will ask the students to do the exercise 1 unit 2 page 21 (Home assignment)

یونٹ
2

الجبری عوامل

جمع کا عمل

1. ایک ہندسی اعداد کی جمع (مجموعہ 18 تک)

1. کتنے پھول ہیں؟

2 + 9 = 11
یا
9 + 2 = 11

$$\begin{array}{r} 9 \\ +\ 2 \\ \hline 11 \end{array}$$

سرگرمی

2. کتنی گیندیں ہیں؟

4 + 9 = ______

3. کتنے مثلث ہیں؟

3 + 8 = ______

4. کتنی چیزیں ہیں؟

6 + 7 = ______

5. کتنے ستارے ہیں؟

5 + 6 = ______

20

حل کیجیے۔

1.	2.	3.	4.
$\begin{array}{r} 3 \\ +\ 7 \\ \hline \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +\ 4 \\ \hline \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +\ 3 \\ \hline \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +\ 2 \\ \hline \\ \hline \end{array}$
5.	**6.**	**7.**	**8.**
$\begin{array}{r} 9 \\ +\ 9 \\ \hline \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +\ 2 \\ \hline \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +\ 9 \\ \hline \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +\ 8 \\ \hline \\ \hline \end{array}$

حل کیجیے۔

9. $6 + 8 = \square$ 10. $7 + 7 = \square$

11. $3 + 9 = \square$ 12. $6 + 7 = \square$

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Recognize the sign (x) for multiplication.
- Explain that multiplication allows us to do repeated addition quickly and efficiently.

Class: II

Subject: Mathematics

Topic: Multiplication

Key words:

Multiplication, x

Time frame:

45 minutes

Demonstration Lesson # 2
Sindh Text Book Board, Book 2

PHASE 1	**ACTIVATING BACKGROUND KNOWLEDGE**
Time:	7 minutes
Techniques:	Think-pair-share, whole class discussion,
Resources:	25 buttons for each group
Directions:	Step 1: The teacher will divide the class into groups and distribute 25 buttons to each group. Step 2: He/she will ask students to make five pairs of buttons. Step 3: He/She will initiate discussion with the help of following questions: ➢ How many groups are there? ➢ How many buttons in each group? ➢ Find out the total number of buttons. Step 4: He/she will encourage learners to share their process of counting.

PHASE 2	**CONSTRUCTING MEANING**
Time:	20 minutes
Techniques:	Think-pair-share, hands on activity, small group discussion,
Resources:	Buttons, sheets for presentation
Directions:	Step 1: The teacher will write the mathematical process and explain. $2+2+2+2+2=10$ We can also write it in following way $2\times5=10$ Step 2: He/she will ask them to make the following groups and write them as he had explained in step 1.

	Make 3 groups of 5 Make 5 groups of 7 Make 4 groups of 3 Make 6 groups of 4 Step 3: He/she will encourage them to write their finding on a big sheet for presentation.

PHASE 3	**EVALUATING AND APPLYING**
Time:	18 minutes
Techniques:	Presentation, whole class discussion
Resources:	Textbook
Directions:	Step 1: The teacher will encourage participants to share their findings. Step 2: .He/She will ask the participants to do exercise 15, unit 2 page no. 45. (Home assignment)

ضرب کا عمل

16. ضرب کا تصور (تکرارِ جمع)

مندرجہ ذیل مثال پر غور کیجیے۔

پانچ جوڑے گلاس کے دیئے ہوئے ہیں۔ کُل کتنے گلاس ہوں گے؟

ہم گلاسوں کی تعداد آسانی سے **2** کو پانچ بار جمع کر کے معلوم کر سکتے ہیں۔ یعنی

2+2+2+2+2=10

پانچ بار دو کو اس طرح لکھتے ہیں۔ **5 x 2 = 10**

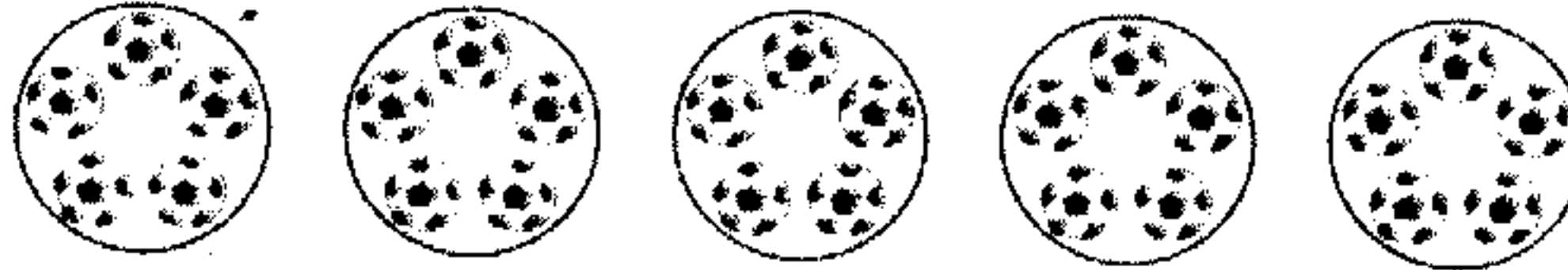
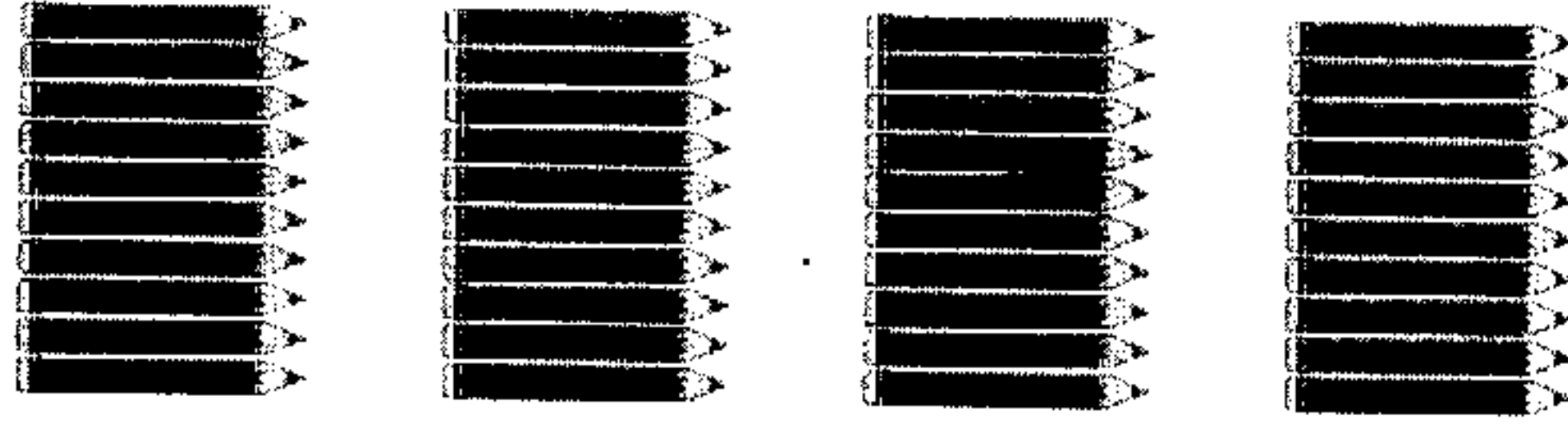
جسے پڑھتے ہیں: **5** ضرب **2** برابر ہے **10**۔

یہاں "**x**" ضرب کی علامت ہے۔

یعنی بار بار جمع کرنے کے عمل کو ضرب کہتے ہیں۔

سرگرمی کُل کتنی گیندیں ہیں؟

پانچ بار پانچ = ___ + ___ + ___ + ___ + ___ = ☐

یا **5 x 5 =** ☐

سرگرمی کُل کتنی پنسلیں ہیں؟

چار بار دس = ____ + ____ + ____ + ____ = [ ]

یا 4 x 10 = [ ]

مشق 15

نیچے دیے ہوئے سوالات حل کیجیے۔

4 x 2 = [2] + [2] + [2] + [2] = [8]

2 x 5 = [ ] + [ ] = [ ]

3 x 10 = [ ] + [ ] + [ ] = [ ]

2 x 10 = [ ] + [ ] = [ ]

3 x 2 = [ ] + [ ] + [ ] = [ ]

4 x 5 = [ ] + [ ] + [ ] + [ ] = [ ]

5 x 10 = [ ] + [ ] + [ ] + [ ] + [ ] = [ ]

3 x 5 = [ ] + [ ] + [ ] = [ ]

4 x 10 = [ ] + [ ] + [ ] + [ ] = [ ]

5 x 2 = [ ] + [ ] + [ ] + [ ] + [ ] = [ ]

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Derive the principle of addition and subtraction of even and odd numbers.

Class: III

Subject: Mathematics

Topic: Even and Odd Numbers

Key words:

Even and Odd Numbers

Time frame:

45 minutes

Demonstration Lesson # 3
Sindh Text Book Board, Book 3

A: Odd	B: Operation	C: Odd	D: Result
	+		

Observation

Result will be in column ___

Group E
Fill in the grid with numbers in column A and C.

A: Odd	B: Operation	C: Odd	D: Result
	+		

Observation

Result will be in column ___

Group F
Fill in the grid with numbers in column A and C.

A: Odd	B: Operation	C: Odd	D: Result
	—		

Observation

Result will be in column ___

Group A
Fill in the grid with numbers in column A and C.

A: Odd	B: Operation	C: Odd	D: Result
	+		

Observation

Result will be in column ___

Group B
Fill in the grid with numbers in column A and C.

A: Odd	B: Operation	C: Odd	D: Result
	+		

Observation

Result will be in column ___

Group C
Fill in the grid with numbers in column A and C.

A: Odd	B: Operation	C: Odd	D: Result
	—		

Observation

Result will be in column ___

black board. (Below is what the table would look on the black board.

Even	Operation	Even	Result
2	+	4	6
8	+	6	14
10	+	12	22
4	+	8	12

Observation
When we add an even number with another even numbers we get a even number

Result
Even number + Even number = Even numbers

Step 3: He/She will distribute the worksheet to the students. Different groups will be given different tasks. (See handout)

Step 4: The teacher will ask learners to prepare for a presentation

PHASE 3 **EVALUATING AND APPLYING**

Time: 20 minutes

Techniques: Presentation, whole class discussion

Resources: Textbook

Directions: Step 1: The teacher will encourage learners to present their findings. After each presentation, the teacher will encourage other groups to ask questions.

Step 2: .He/she will ask the students to do the exercise 21 unit 2 page no. 34. (Home assignment)

PHASE 1 **ACTIVATING BACKGROUND KNOWLEDGE**

Time: 5 minutes

Techniques: Think-pair-share, whole class discussion,

Resources: Worksheet

Directions: Step 1: The teacher will write the following table.

Even	Operation	Even	Result
	+		

Observation

Result

Step 2: He/she will elicit even numbers and write them in the columns.

Step 3: He/she will ask students to work in pairs, add the numbers in first and third columns and write them in the result column.

Step 4: He/she will fill in the result column on the black board with the help of students.

PHASE 2 **CONSTRUCTING MEANING**

Time: 20 minutes

Techniques: Group work, hands on activity, small group discussion,

Resources: Buttons, Work Sheet

Directions: Step 1: The teacher will ask students to work in groups, reflect on the table and find the pattern they observed.

Step 2: He/she will encourage students to share their finding with the teacher and he/she will write on the

۴۔ حمید صاحب کے پاس 50000 روپے ہیں۔ اگر وہ 1250 روپے زکوۃ ادا کرتا ہے، تو باقی رقم معلوم کیجیے

(8) جفت اور طاق اعداد کی جمع اور تفریق کے اُصول

مندرجہ ذیل مثالوں پر غور کیجیے۔

8	16	20	88	1524
+ 6	+ 24	+ 86	+ 66	+ 6848
14	40	106	154	8372

(8 + 6 = 14، 16 + 24 = 40، 20 + 86 = 106، 88 + 66 = 154 اور 1524 + 6848 = 8372)

پہلا اصول: اگر ہم کسی بھی دو جفت اعداد کو جمع کرتے ہیں، تو ہمیں ایک جفت عدد حاصل ہوتا ہے۔

اب مندرجہ ذیل مثالوں پر غور کیجیے۔

7	17	45	103	83051
+ 5	+ 11	+ 73	+ 99	+ 60843
12	28	118	202	143894

(7 + 5 = 12، 17 + 11 = 28، 45 + 73 = 118، 103 + 99 = 202 اور 83051 + 60843 = 143894)

دوسرا اصول: اگر ہم کسی بھی دو طاق اعداد کو جمع کرتے ہیں تو ہمیں جفت عدد حاصل ہوتا ہے۔

اب مندرجہ ذیل مثال پر غور کیجیے۔

60002	255	33	26	8
+ 29503	+ 324	+ 44	+ 13	+ 9
89505	579	77	39	17

تیسرا اصول: اگر ہم جفت عدد اور طاق عدد کو جمع کرتے ہیں تو ہمیں طاق عدد حاصل ہوتا ہے۔

اب یہ مثالیں دیکھیے۔

8520	212	36	20	8
− 4896	− 104	− 28	− 14	− 4
3624	108	8	6	4

چوتھا اصول: اگر ہم کسی بھی دو جفت اعداد کو تفریق کرتے ہیں تو ہمیں جفت عدد حاصل ہوتا ہے۔

یہ مثالیں دیکھیے۔

68999	507	89	33	9
− 56893	− 295	− 63	− 21	− 5
12106	212	26	12	4

پانچواں اصول: اگر ہم کسی بھی دو طاق اعداد کو تفریق کرتے ہیں تو ہمیں جفت عدد حاصل ہوتا ہے۔

ان مثالوں پر غور کیجیے۔

10001	483	19	5
− 9580	− 252	− 16	− 4
421	231	3	1

چھٹا اصول: اگر ہم کسی طاق عدد میں سے جفت عدد تفریق کرتے ہیں تو ہمیں طاق عدد حاصل ہوتا ہے۔

اب یہ مثالیں دیکھیے۔

100000	688	28	8
− 98937	− 505	− 17	− 3
1063	183	11	5

ساتواں اصول: اگر ہم جفت عدد میں سے طاق عدد تفریق کرتے ہیں تو ہمیں طاق عدد حاصل ہوتا ہے۔

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- See/discover a pattern of relation between the number of zeros and number of decimal places.
- Use the term tenth and hundredth to refer to decimal fractions.
- Realise that normal fractions can be converted to decimals by division.

Class: III

Subject: Mathematics

Topic: Decimal fraction

Key words:

Fraction, Decimal Fraction, tenth, hundredth

Time frame:

45 minutes

Demonstration Lesson # 4
Sindh Text Book Board, Book 3

PHASE 1	ACTIVATING BACKGROUND KNOWLEDGE
Time:	5 minutes
Techniques:	Think-pair-share, small group discussion, whole class discussion,
Resources:	Simple calculators, worksheet A
Directions:	Step 1: The teacher will divide the class into groups. Step 2: The teacher will distribute the worksheet A among the students and explain the task.

PHASE 2	CONSTRUCTING MEANING
Time:	30 Minutes
Technique:	Group work, hands on activity, small group discussion
Resources:	Worksheet B
Directions:	Step 1: The teacher will discuss with students using the following questions. ➢ What do you notice? ➢ Is there any pattern? Step 2: After finding the pattern together, the teacher will distribute worksheet B and explain the task. Step 3: He/she will invite groups to share their work and give feedback on their work.

PHASE 3	**EVALUATING AND APPLYING**
Time:	10 minutes
Techniques:	Presentation, whole class discussion
Resources:	Students' input
Directions:	Step 1: The teacher will ask groups to share their key learning of the day with other group member and write it in their note books.

Fraction and Decimal Fraction

Worksheet A: Convert the given fraction into decimal fraction by using a calculator. For example $(3 \div 10 = ?)$, $(3 \div 100 = ?)$

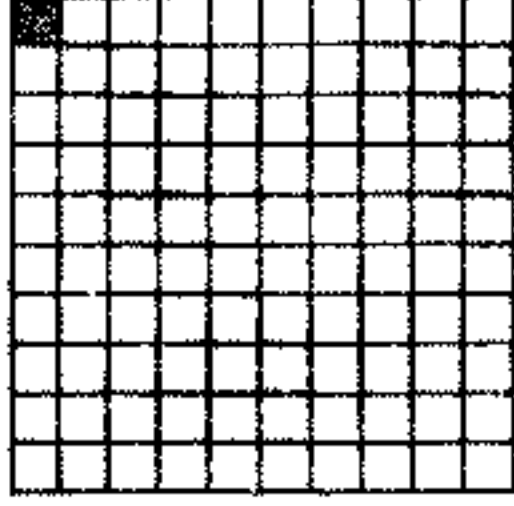
No.	Fraction	Decimal fraction
1	$\frac{3}{10}$	
2	$\frac{3}{100}$	
3	$\frac{6}{10}$	
4	$\frac{23}{100}$	
5	$\frac{30}{100}$	
6	$\frac{5}{10}$	
7	$\frac{8}{100}$	
8	$\frac{50}{100}$	
9	$\frac{7}{100}$	

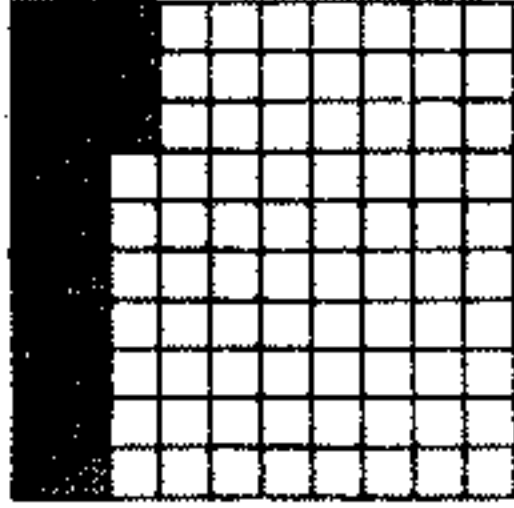
Fraction and Decimal Fraction

Wroksheet B: work out the following without using calculators.

No.	Fraction	Decimal fraction	Read as
1	$\frac{4}{10}$		four tenths
2	$\frac{25}{100}$		
3	$\frac{9}{10}$		
4	$\frac{27}{100}$		twenty seven hundredths
5	$\frac{40}{100}$		
6	$\frac{8}{10}$		
7	$\frac{5}{100}$		
8	$\frac{60}{100}$		
9	$\frac{90}{100}$		

(ii) سوواں

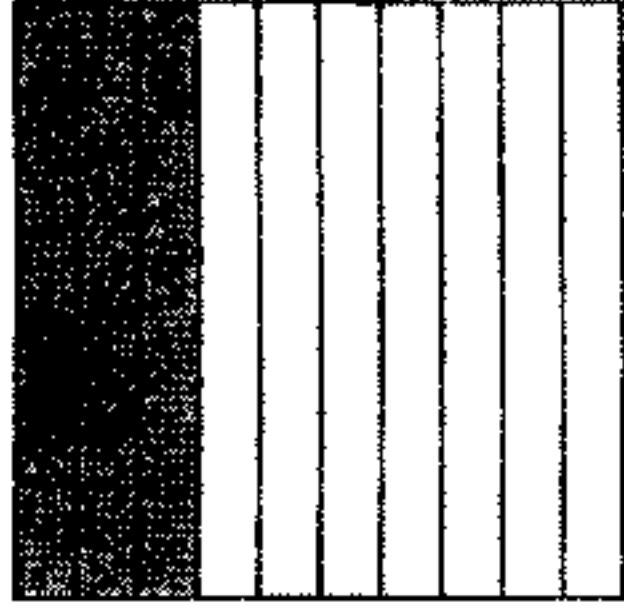
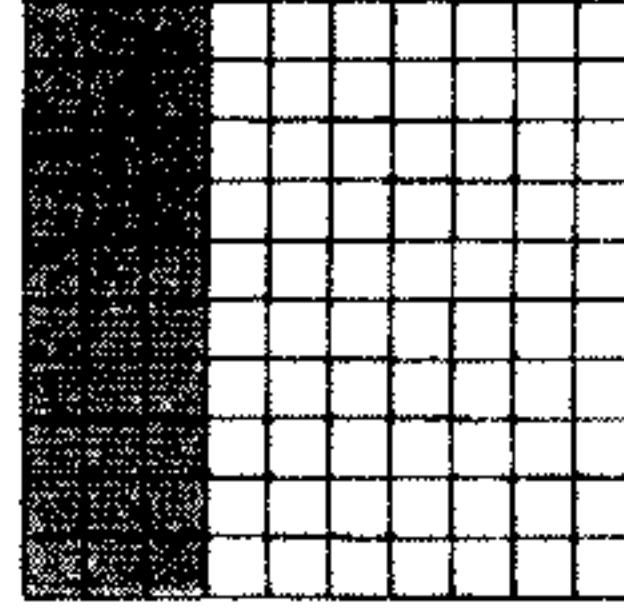
دی گئی شکل کو 100 برابر حصوں میں تقسیم کیا گیا ہے۔ رنگدار حصہ 100 حصوں میں سے ایک ہے۔ اس حصے کو $\frac{1}{100}$ سے ظاہر کرتے ہیں۔ ہم اسے شکل کا ایک سوواں حصہ کہتے ہیں۔ کسور اعشاریہ میں اس کسر $\frac{1}{100}$ کو .01 لکھا جاتا ہے۔ اسے "اعشاریہ صفر ایک" پڑھا جاتا ہے۔

دی گئی اسی شکل میں 100 برابر حصوں میں سے 99 کو رنگا نہیں گیا ہے۔ یہ کسر عام $\frac{99}{100}$ کو ظاہر کرتا ہے۔ ہم کسر عام $\frac{99}{100}$ کو کسر اعشاریہ میں ".99" لکھتے ہیں۔

اسے "اعشاریہ نو نو" پڑھتے ہیں۔

اس شکل میں 100 برابر حصوں میں سے 23 یا $\frac{23}{100}$ حصہ رنگدار ہے۔

کسر عام $\frac{23}{100}$ کو کسر اعشاریہ میں یوں .23 لکھتے ہیں۔

اسے "اعشاریہ دو تین" پڑھتے ہیں۔

(iii) دسویں اور سوویں میں تعلق

مندرجہ ذیل اشکال دیکھیں۔

30 سوویں

3 دسویں

دی گئی ان دونوں اشکال میں پہلی شکل، کسر $\frac{3}{10}$ یا 0.3 (3 دسویں) کو ظاہر کرتی ہے۔ دوسری شکل کسر عام $\frac{30}{100}$ یا 0.30 کو ظاہر کرتی ہے۔

دونوں اشکال کو دیکھنے سے ہم یہ نتیجہ اخذ کرتے ہیں کہ دونوں اشکال کا رنگدار حصہ یکساں ہے۔ پس کسر اعشاریہ .3 کو یوں 0.30 لکھ سکتے ہیں یعنی

$$0.3 = 0.30$$

یعنی ہم کہہ سکتے ہیں کہ تین دسویں، تیس سوویں کے برابر ہے۔
اسی طرح کسرِ اعشاریہ 0.5 کو 0.50 لکھ سکتے ہیں۔ یعنی

$0.\dot{5} = 0.50$

یعنی ہم کہہ سکتے کہ پانچ دسواں، 50 سوویں کے برابر ہیں۔

سرگرمی: مندرجہ ذیل کسورِ اعشاریہ کو الفاظ میں لکھیے۔

	کسورِ اعشاریہ	
دوسوویں یا $\frac{2}{100}$	.02	اعشاریہ صفر دو
تین سوویں یا $\frac{3}{100}$	.03	
چار سوویں یا $\frac{4}{100}$	.04	
نو سوویں یا $\frac{9}{100}$	.09	
بارہ سوویں یا $\frac{12}{100}$	.12	اعشاریہ ایک دو
بیس سوویں یا $\frac{20}{100}$	.20	
50 سوویں یا $\frac{50}{100}$	.50	
79 سوویں یا $\frac{79}{100}$	.79	
86 سوویں یا $\frac{86}{100}$	.86	
98 سوویں یا $\frac{98}{100}$	.98	

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Understand and recognize the concepts of unit, ten, and hundreds.
- Count numbers one through nine, add these numbers successfully, and learn a simple method of solving addition problems with three-digit numbers.

Class: III

Subject: Mathematics

Topic: Addition up to three digits

Key words:

Addition +, tens, hundreds

Time Frame:

45 minutes

Demonstration Lesson # 5

PHASE 1 **ACTIVATING BACKGROUND KNOWLEDGE**

Time: 7 Minutes

Techniques: KWL

Resources: KWL chart

Directions: Step 1: The teacher will write the following on a chart or blackboard (if available).

What I Know (K)	What I Want to Know (W)	What I Learned (L)

Step 2: The teacher will ask students where they see numbers in their daily lives, to share any experience they have had with adding numbers. Remind the children of simple one-digit addition. For example, the teacher could say,

"When I add one number (3) to another number (5) the sum of these two numbers (3+5 = 8) is bigger than each of the numbers."

Step 3: The teacher will write the students' comments and the 3 + 5 = 8 example on the chart or blackboard (if available) in the "What I Know" column.

PHASE 2 **CONSTRUCTING MEANING**

Time: 25 minutes

Techniques: Small group discussions, think aloud, teacher explanation

Resources: Charts

Directions: Step 1: Teacher will ask children what they would like to know about addition. Write their comments in the "W"

column of the chart (if available). Students may say that they want to know how to add bigger numbers. If not, the teacher could say, "It would be fun and useful to know how to add three-digit numbers" and write "How do you add three digit numbers?" in the "W" column of the chart (if available).

Note to the teacher:

If you have a chart or blackboard, write an addition problem with three-digit numbers on the board. Tell the children the rule of addition: unit (the 'ones') is added into unit only and tens to tens only, and hundreds to hundreds.

Solve the problem on the chart or board, talking out loud about the problem as you solve it.

For example:

Write on board:

$$\begin{array}{r} 342 \\ +\ \underline{231} \end{array}$$

Say: "I must first add the units, and I know that 2 plus 1 equal 3. I can only add tens to tens, and I know 4 plus 3 equals 7. I can only add hundreds to hundreds, and I know that 3 plus 2 equals 5. So when I solve my problem, I can see that 342 plus 231 equals 573."

Now the board should show:

$$\begin{array}{r} 342 \\ +\ \underline{231} \\ 573 \end{array}$$

Complete several more problems using the Think Aloud protocol. As students grasp the concept, call on students to add units, tens, and hundreds as you write on the chart or board. Ask students to "think out loud" as they add.

Step 2: Ask students to tell stories that involve adding large sums. The idea is for students to see that mathematics is related to life experience because primary students learn through relating to concrete examples. The story should make sense and be in keeping with the size of the numbers. For example, a student could describe adding 132 rupees and 452 rupees to make 584 rupees.

PHASE 3	**EVALUATING AND APPLYING**
Time:	12 minutes
Techniques:	Group work
Resources:	Text book for class 3 page 27 (Baluchistan)
Directions:	Step 1: The teacher will ask students to complete addition of three-digit numbers from their textbook page 15. When everyone is finished, they can share their answers with a partner to discuss and correct any differences in their answers to the sums. Finally, he/she will ask students to share answers with the whole class; you may ask them to write their sums on the blackboard or chart. Step 2: Teacher will ask students, "What have we learned today?" and write their comments in the "L" column of the chart or blackboard (if available). Encourage students to discuss how we use three-digit addition in our daily lives and write some comments in the "L" column.

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Understand the concept of highest common factors.
- Recognize these factors from given numbers.
- Use Venn diagram technique to solve mathematical problems.

Class: III

Subject: Mathematics

Topic: Highest common factor

Key words:

Factor, common, highest, Venn diagram

Time fame:

45 minutes

Demonstration Lesson # 6

PHASE 1	**ACTIVATING BACKGROUND KNOWLEDGE**
Time:	12 minutes
Techniques:	Q & A, whole class discussion
Resources:	None
Directions	Step 1: Students should already know the terms and concepts "highest," "factor," and "common." The teacher will hold a short activity to remind students of these terms. For example, make marks on a chart or a blackboard and point out which is high, higher, and highest. Then, he/she will talk about "common" as things that are similar, or the opposite of concepts like "different" or "uncommon." Finally, students are asked to recall the definition of "factor": one of two or more numbers that can be divided into a given number without a remainder, in the formula "a and b are factors of ab." For example, 2 and 4 are factors of 8; 3 and 5 are factors of 15; 6 and 9 are factors of 54. Step 2: When the teacher is sure that all students understand "highest," "common," and "factor," it is time to make a list of numbers. He/she calls on students to contribute any numbers they can think of up to the number 20. He/she will write the numbers in a box on the blackboard or chart (if available). For example: **6, 8, 3, 10, 19, 15, 20, 5, 12, 16,** **(Numbers)** **9, 11, 18, 2, 4, 17, 14, 6, 13, 7, 1,** Step 3: Next, the teacher will write three circles on the board or chart (if available), and label them "FACTORS OF 10," "FACTORS OF 15," AND "FACTORS OF 20." Also, the teacher will ask students to make the circles on their own paper (if available). The teacher will ask students to help in organizing the numbers into categories by placing each number in the appropriate circle. For example:

The teacher will make sure that the students fill in the circles on their papers as you fill in the circles on the chart or blackboard.

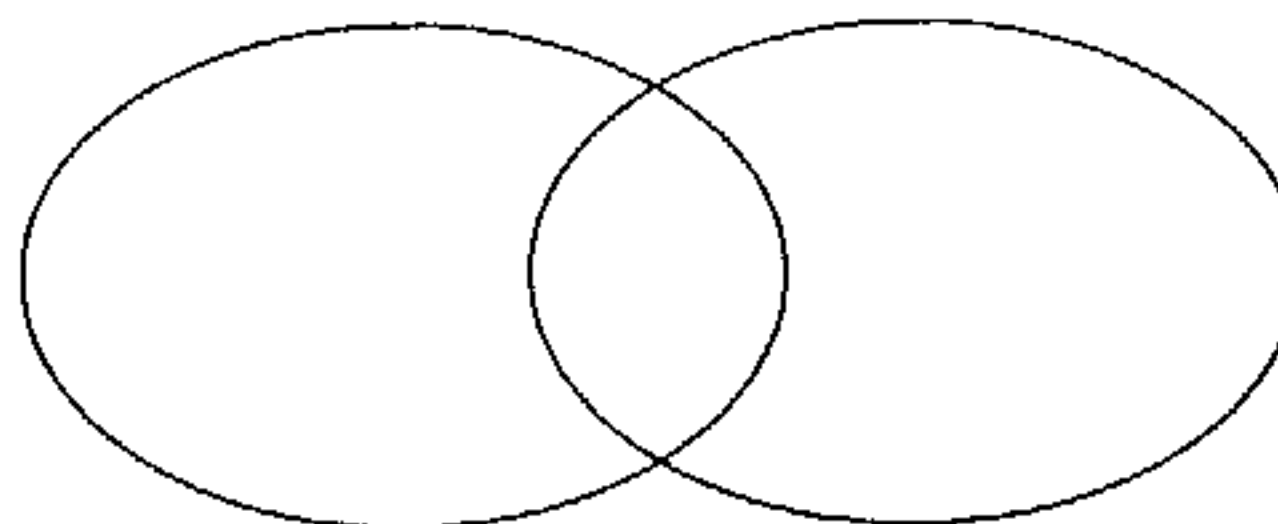
PHASE 2 **CONSTRUCTING MEANING**

Time: 18 minutes

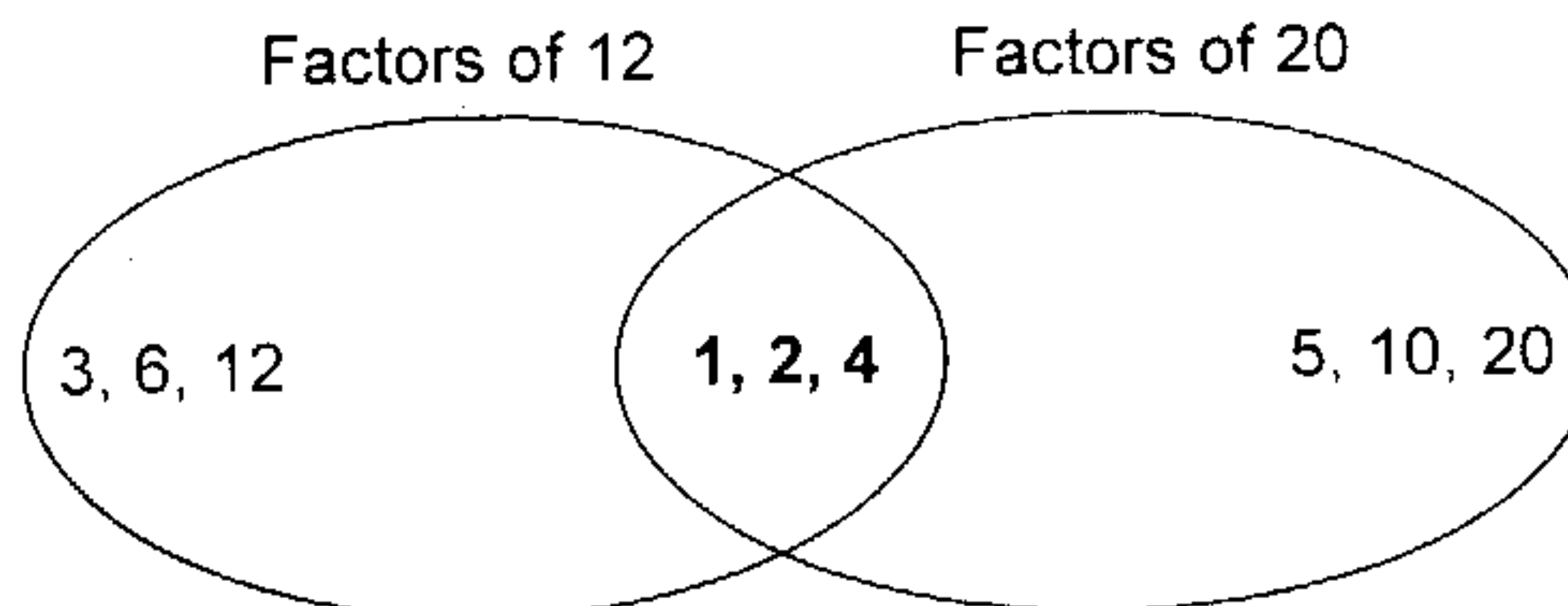
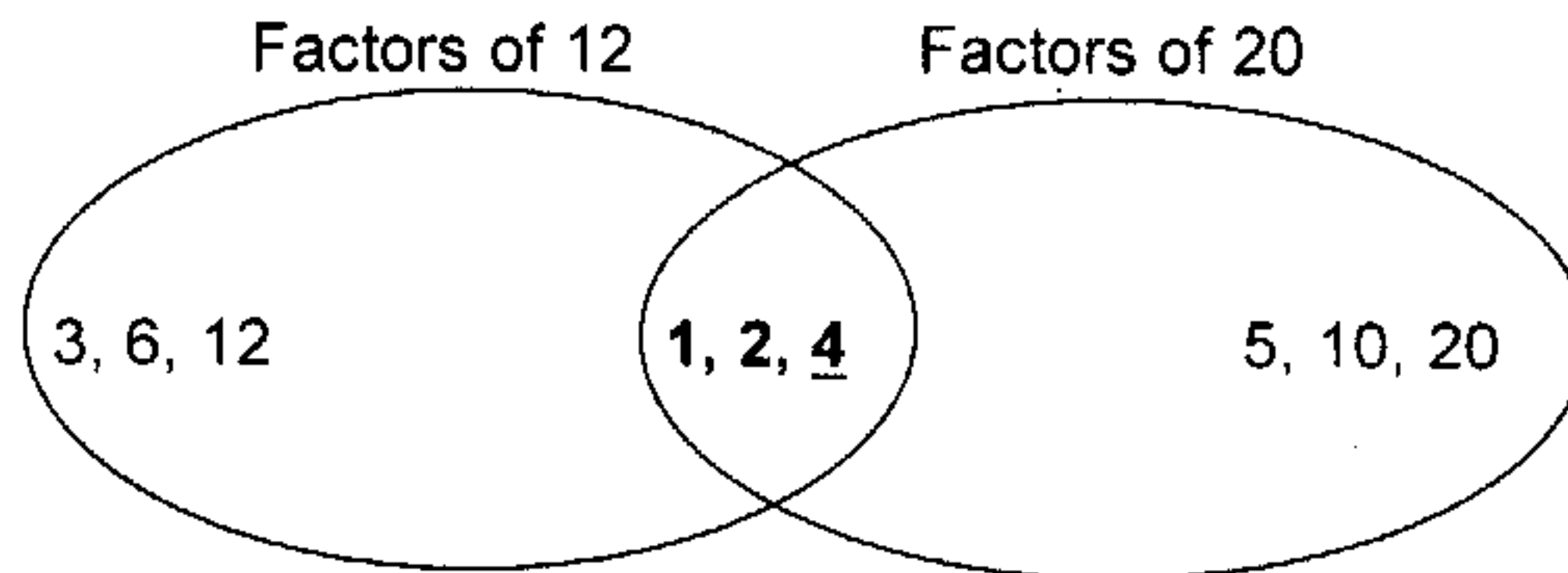
Techniques: Teacher's presentation, whole class discussion

Resources: None

Directions

Step 1: The teacher will draw a Venn diagram on the blackboard or chart (if available), with two intersecting circles:

He/she will label one circle "Factors of 12" and the other "Factors of 20." fill in each circle using the numbers in the circles. The factors that each number have *in common* should go in the middle; the factors that are different go in the outside portions of each circle:

Factors of 12 Factors of 20

3, 6, 12 **1, 2, 4** 5, 10, 20

The teacher will explain to students that the numbers 12 and 20 have three factors in common: 1, 2, and 4. The other factors of 12 and of 20, in the outsides of the circles, are different. Among the *common* factors, 4 is the *highest*. Underline the 4. Tell students, "For the numbers 12 and 20, 4 is the highest common factor."

PHASE 3	**EVALUATING AND APPLYING**
Time:	15 minutes
Techniques:	Group work
Resources:	Textbook page 24, exercise 2.5
Directions:	Step 1: The teacher will ask students go through the same exercises using different numbers. The exercises can be from a textbook. If no textbook is used, then have students use Venn Diagrams to find the highest common factors between these sets of numbers: 10 and 15; 9 and 18; 20 and 30; and 16 and 24. After students have worked on their own, then each student will be asked to compare answers with a partner and correct any differences in their answers. Step 2: The students should contribute as the teacher complete all four problems on the chart or board. The class is encouraged to discuss and to ask questions.

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Understand and recognize three types of angles: right, obtuse, and acute.
- Understand and recognize three common types of triangles: equilateral, isosceles, and right.
- Describe how right triangles, isosceles triangles, and equilateral triangles are alike and how they are different.

Class: III

Subject: Mathematics

Topic: Triangle

Key words:

Right angle, obtuse angle, acute angle, right triangle, equilateral triangle, isosceles triangle

Time Frame:

45 minutes

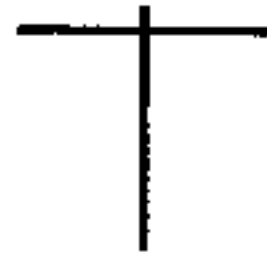
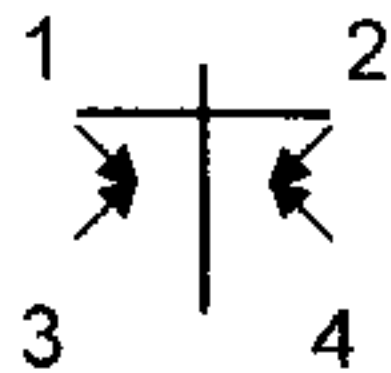
Demonstration Lesson # 7

PHASE 1	**ACTIVATING BACKGROUND KNOWLEDGE**
Time:	10 minutes
Techniques:	Show and tell
Resources:	Pictures of different Shapes
Directions:	Step 1: The teacher will select photographs or draw pictures that include basic geometric shapes including rectangles (for example, a box or a building), circles (for example, a clock or a ball), and triangles (for example, a pyramid, a slice of pie, or a boat's sail). He/she will show them to students and ask students to identify the shapes that they see. He/she will write the names of the shapes on the chart or blackboard (if available) and draw the shapes next to them. For example: circle ◯ square □ Step 2: The teacher will say, "All shapes are made of lines – sometimes curved, as in a circle, and sometimes straight, as in a square. When shapes have straight lines that come together, the place where the lines meet is called an *angle*. If students already have studied angles, then he/she will hold a short discussion during which students share what they know. If they have not learned about angles, then the angles in the shapes will be pointed on the board.

PHASE 2	**CONSTRUCTING MEANING**
Time:	15 minutes
Techniques:	Think aloud, draw, group work
Resources:	Drawing by the teacher,
Directions	Step 1: Some students may understand *acute angle, obtuse angle,* and *right angle*. If so, allow students to work in groups and for these students to share what they know with other students. The teacher will hold a whole-class discussion so that everyone has an understanding of these types of angles.

Note to the teacher:

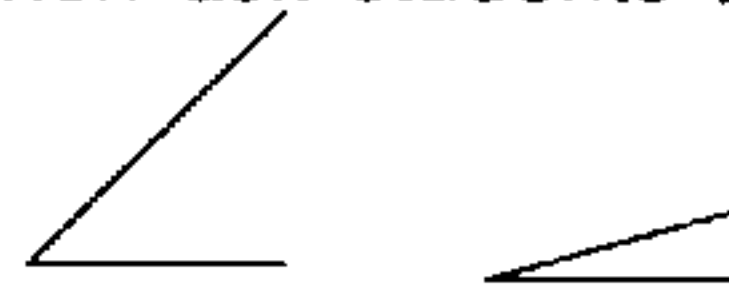
If students are not yet familiar with *acute angle, obtuse angle,* and *right angle*, then teach these simple concepts using Think Aloud. "Think out loud" as you draw on the board and explain what you are doing.

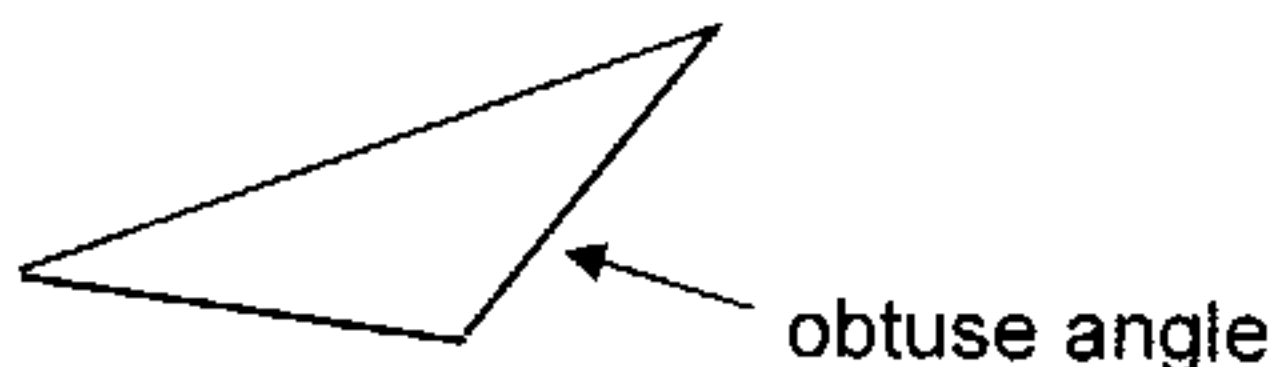
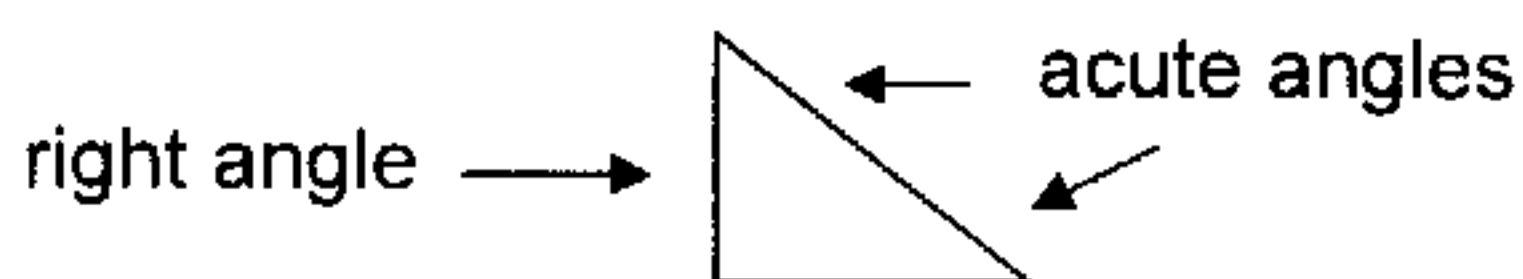
First, draw two lines on the board so that they intersect, like this:

Using Think Aloud, tell students that there are four *right angles* (also known as 90 degree angles) in this drawing, at each of the points where the two lines meet. For advanced students, you can tell them that two lines that intersect in a right angle are called *perpendicular*.

Ask students to identify areas in the classroom where they can find right angles (such as where the wall meets the floor; if you stand a book up on a table; or the English capital letter "L").

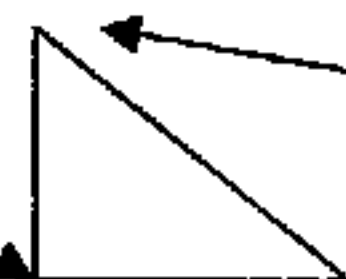
Step 2: Use Think Aloud which explaining to students that when an angle is BIGGER than a right angle, it is called OBTUSE. Draw an example on the chart or board, and then ask students to draw more examples.

Examples of obtuse angles:

Explain to students that when an angle is SMALLER than a right angle, it is called ACUTE. Draw an example on the chart or board, and then ask students to draw more examples.

Examples of acute angles

Step 3: Explain that an EQUILATERAL TRIANGLE has THREE EQUAL SIDES and THREE EQUAL ANGLES, WHICH ARE ALL ACUTE. For example:

Explain that an ISOSCELES TRIANGLE has TWO SIDES THAT ARE EQUAL LENGTH, but not three. An ISOSCELES TRIANGLE MAY HAVE ACUTE AND OBTUSE ANGLES. Draw an example:

Next, explain that a RIGHT TRIANGLE is a special type of isosceles triangle with ONE RIGHT ANGLE AND TWO ACUTE ANGLES in it. Draw an example:

Step 4: Finally, point out to the students that the examples of triangles on the chart or the board have acute, obtuse, and right angles in them. Ask students to point out the acute, obtuse, and right angles. Correct students as necessary so that at the end of the exercise the examples with the angles correctly marked.

For example:

PHASE 3 **EVALUATING AND APPLYING**

Time: 20 minutes

Techniques: Group work

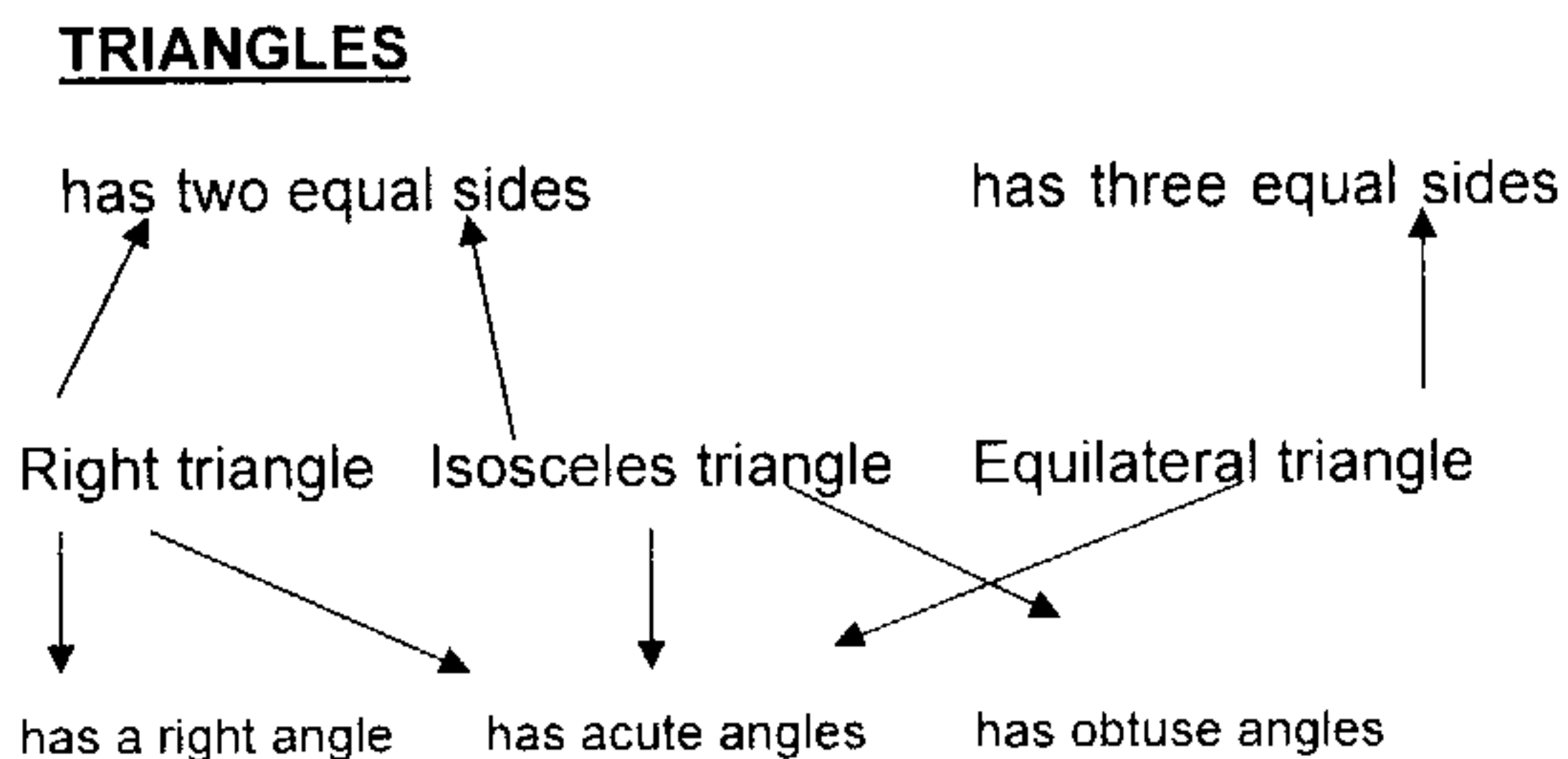
Resources: Geometry box, Charts

Directions: Step 1: The teacher will place students in groups and give each group pictures on which several examples of isosceles, equilateral, and right triangles, are drawn.

Each group should have a ruler to measure the sides of the triangles on their paper (If no rulers are available, then hold a piece of paper to each side of each triangle, and use pencil marks to indicate how long each side is. This way, students can determine which sides are of equal length).

Each group should identify their triangles as isosceles, equilateral, or right triangles.

Step 2: Using what they now know, each group can create a Concept Web about triangles. Their Concept Webs should have the word "Triangles" at the top, either circled or underlined, and they should include the terms: sides, angles, right angle, acute angle, obtuse angle, equilateral triangle, right triangle, isosceles triangle. Once webs are complete, the teacher will invite a discussion about the similarities and differences between the different types of triangles. The Concept Webs will differ from each other, but might look like this:

TRIANGLES

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Explain prime factors
- Calculate prime factors.

Class: IV

Subject: Mathematics

Topic: Prime factor

Key words:

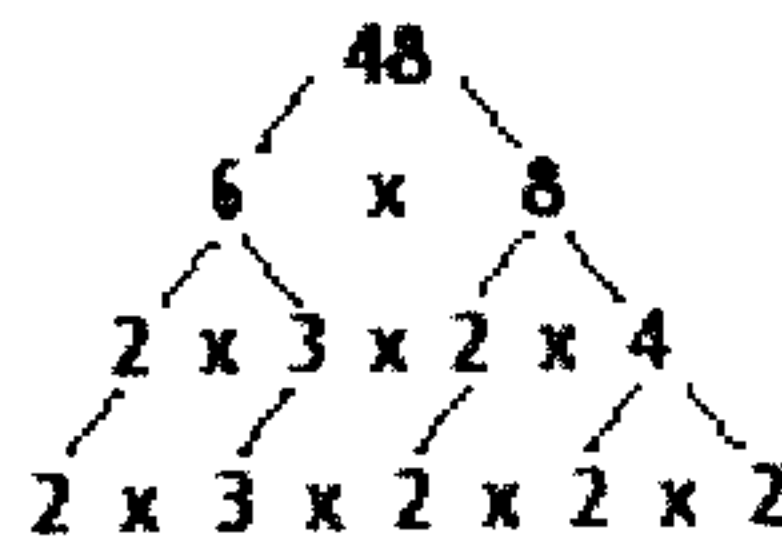
Prime factor, factor tree

Time frame:

45 minutes

Demonstration Lesson # 8
Sindh Text Book Board, Book 4

PHASE 1	**ACTIVATING PRIOR KNOWLEDGE**
Time:	8 minutes
Techniques:	Think-pair-share, whole class discussion,
Resources:	Learners' input
Directions:	Step 1: The teacher will ask learners to think of a prime numbers and share in their group. Step 2: The teacher will encourage group members to share their number with the whole class. He will also write those numbers on the black board. Step 3: The teacher will write the word "Prime Factor" on the board and ask the students what they know about that word.

PHASE 2:	**CONSTRUCTING MEANING**
Time:	22 Minutes
Techniques:	Group work, hands on activity, small group discussion,
Resources:	None
Directions:	Step 1: The teacher will write the number 48 on the board and ask. ➢ Who will tell me two such numbers whose final product will be 48. Step 2: He/she will continue asking such questions and with the responses will develop following factor tree.

Step 3: He/she will write prime factors of 48 on the board and explain the prime factors

Prime factors of 48 are $2\times 3\times2\times2\times2$

Step 4: He/she will give the following numbers to find the prime factors.

Group A: 72, 54
Group B: 36, 42
Group C: 100, 38
Group D: 50, 90
Group E: 63, 80

Step 5: He/she will ask students to choose one of their answers for presentation and write them on chart paper/used calendar.

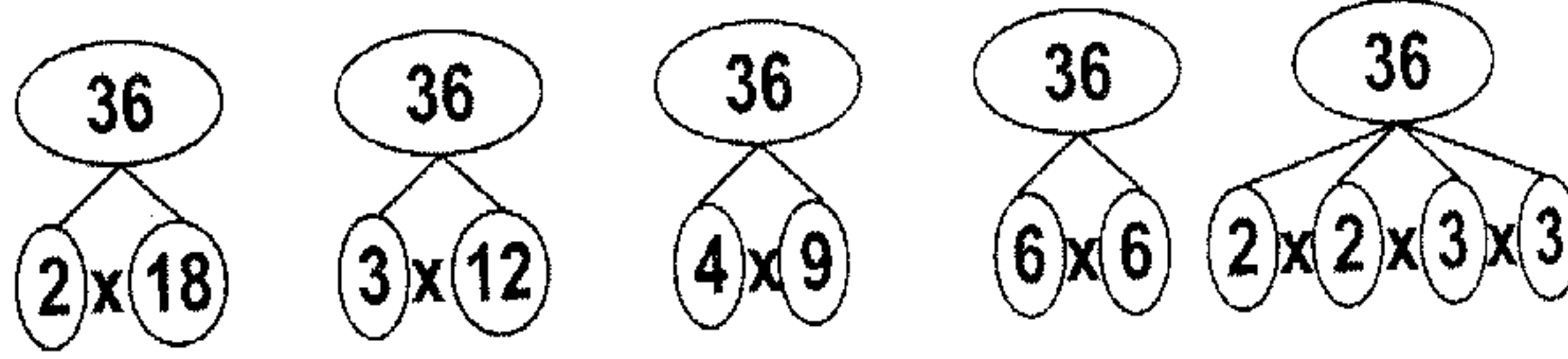
PHASE 3	**EVALUATING AND APPLYING INFORMATION**
Time:	15 minutes
Technique:	Presentation, whole class discussion
Resources:	Textbook
Directions:	Step 1: The teacher will ask students to present their work. He will also encourage other groups to raise questions. Step 2: The teacher will ask the class to solve the exercise 2.3, unit 2 page no. 18. (Home assignment)

2.6 مفرد تجزی

ایک ایسی تجزی جس میں ہر جز وضربی مفرد ہو اسے مفرد تجزی کہتے ہیں۔

مثال: 36 کے مندرجہ ذیل اجزائے ضربی پر غور کیجیے۔

یعنی

36 = 3 x 12,　36 = 4 x 9,　36 = 6 x 6,

36 = 2 x 2 x 3 x 3,　36 = 2 x 18

36 کی کس تجزی میں تمام اعداد مفرد ہیں؟ 2 x 2 x 3 x 3

پس 36 کی مفرد تجزی 2 x 2 x 3 x 3 ہے۔

اسی طرح ذیل میں 30,12 اور 42 کی مختلف تجزیاں دی گئی ہیں۔

12 = 2 x 6	30 = 3 x 10	42 = 6 x 7
12 = 3 x 4	30 = 2 x 3 x 5	42 = 14 x 3
12 = 2 x 2 x 3	30 = 6 x 5	42 = 2 x 3 x 7

جن میں سے 12, 30 اور 42 کی مفرد تجزیاں یہ ہیں:

12 = 2 x 2 x 3,　30 = 2 x 3 x 5,　42 = 2 x 3 x 7

مثال: 42 کے مفرد اجزائے ضربی معلوم کیجیے۔

حل:

2	42
3	21
7	7
	1

پس 2، 3 اور 7 عدد 42 کے مفرد اجزائے ضربی ہیں۔

مشق 2.3

1۔ مندرجہ ذیل اعداد کے تمام ممکن اجزائے ضربی معلوم کیجیے۔

(i) 10 (ii) 32 (iii) 56 (iv) 72

2۔ مندرجہ ذیل اعداد کی مفرد تجزی معلوم کیجیے۔

(i) 21 (ii) 120 (iii) 200 (iv) 232
(v) 520 (vi) 352 (vii) 950 (viii) 892

3۔ "ہاں" یا "نہیں" میں جوابات لکھیے۔

(i) 66 کی مفرد تجزی 2 x 3 x 11 ہے۔ ☐
(ii) 50 کی مفرد تجزی 2 x 5 x 5 ہے۔ ☐
(iii) 54 کی مفرد تجزی 3 x 3 x 6 ہے۔ ☐
(iv) 28 کی مفرد تجزی 2 x 2 x 7 ہے۔ ☐

LEARNING OUTCOMES

At the end of the lesson, the students will be able to:

- Derive their way of finding area of rectangle.
- Write the formula for the area of rectangle.
- Apply the formula in other fields.
- Calculate the area of rectangle.

Class: V

Subject: Mathematics

Topic: Area of Rectangle

Key words:

Rectangle, breadth, length, area

Time frame:

45 minutes

Demonstration Lesson # 9
Sindh Text Book Board, Book 5

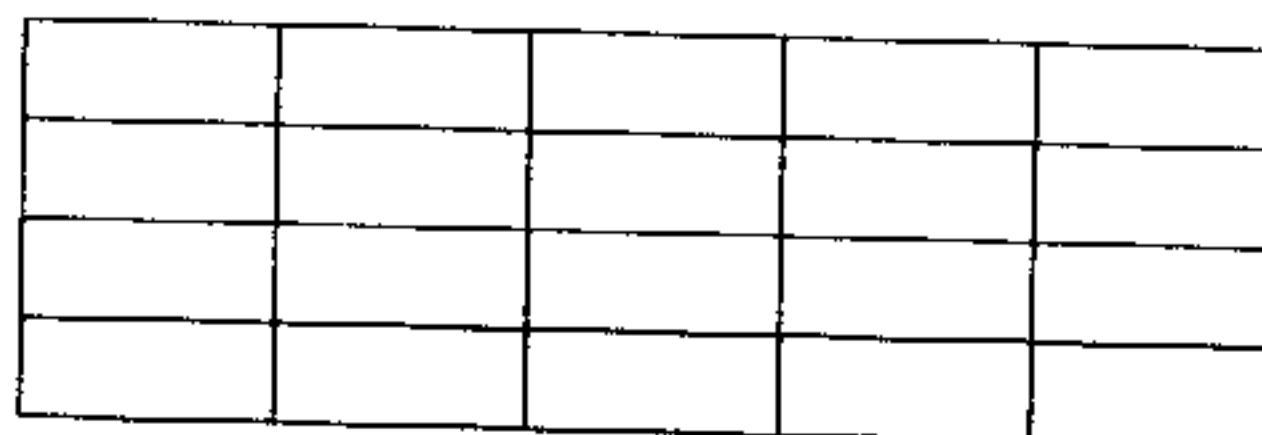
PHASE 1	**ACTIVATING BACKGROUND KNOWLEDGE**
Time:	8 minutes
Techniques:	Brainstorming, Think-pair-share, whole class discussion,
Resources:	Students' input
Directions:	Step 1: The teacher will write the word "Area" on the board and ask students to share what ever they know about area. Step 2: He/she will write all the responses on the board Step 3: He/she will draw the rectangle on the board and ask about width and length.

PHASE 2 **CONSTRUCTING MEANING**

Time: 25 minutes

Techniques: Group work, hands on activity, small group discussion,

Resources: Activity sheet

Directions: Step 1: The teacher will draw a rectangle

Step 2: He/she will ask about its length and breadth and write it on the chart.

Step 3: He/she will ask students to count all the squares in the figure.

Step 4: Here he/she will explain the meaning of area.

Step 5: He/she will draw the following table and fill in the grid.

Length (l)	Breadth (b)	Area
5cm	4cm	20 cm^2

Step 6: The teacher will distribute the square sheet among the students. He/she will ask them to draw the rectangle on square paper and write of length and breadth.

Step 7: He/she will also ask them to count the squares in the rectangle and fill in the above table.

Step 8: He/she will ask the students to discuss in groups of four and find out the relation between the length breadth and the area by observing the table. He/she will observe students and also help/encourage them if they need support.

Step 9: He/she will invite volunteer group(s) to share their finding. He/she will discuss the answers with whole class, reach to a consensus and discover the following formula.

Area of rectangle = Length × breadth

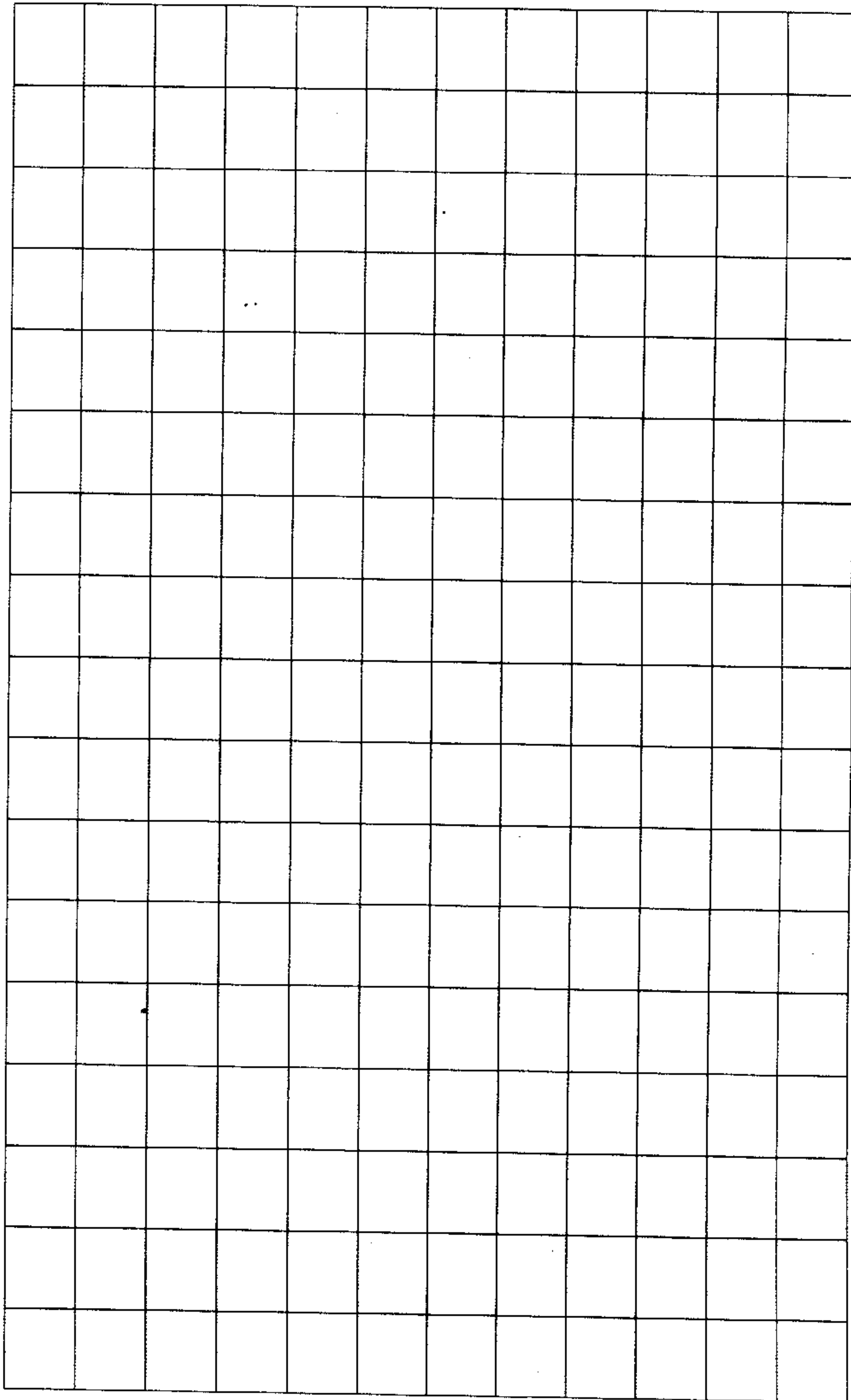
PHASE 3 **EVALUATING AND APPLYING**

Time: 12 minutes in the class + 40 minutes at home

Techniques: Presentation, whole class discussion

Resources: Textbook

Directions: Step 1: The teacher will ask the students to work in their groups and solve the exercise 5.6 unit 5 page no. 61 by using the formula just discovered. He/she will move around the class and give feedback on their work

SQUARE SHEET

شکل 4

کسی بھی بند شکل سے گھرے ہوئے علاقہ کی پیائش کو اُس بند شکل کا رقبہ کہتے ہیں۔

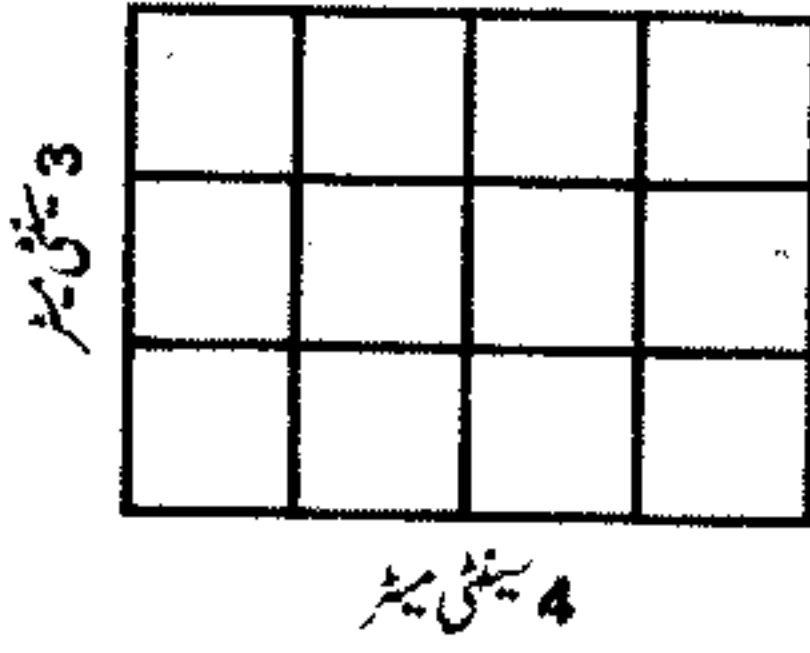
رقبہ کی پیائش ہمیشہ لمبائی کی مربع اکائی میں ہوتی ہے مثلاً مربع میٹر مربع سینٹی میٹر یا مربع کلومیٹر وغیرہ ۔

ایک مستطیل لیجیے جس کی لمبائی 4 سینٹی میٹر اور چوڑائی 3 سینٹی میٹر ہو اس کو 12 مربعوں میں تقسیم کیجیے جس کے ہر ضلع کی لمبائی 1 سینٹی میٹر ہو اس طرح ہر افقی قطار میں 4 مربع، جبکہ ہر کالم میں تین مربع ہیں۔

جیسا کہ سامنے دی گئی شکل میں دکھایا گیا ہے۔

یہاں ہر مربع کا رقبہ 1 مربع سم یا 1 سم^2 ہے۔

3 سینٹی میٹر

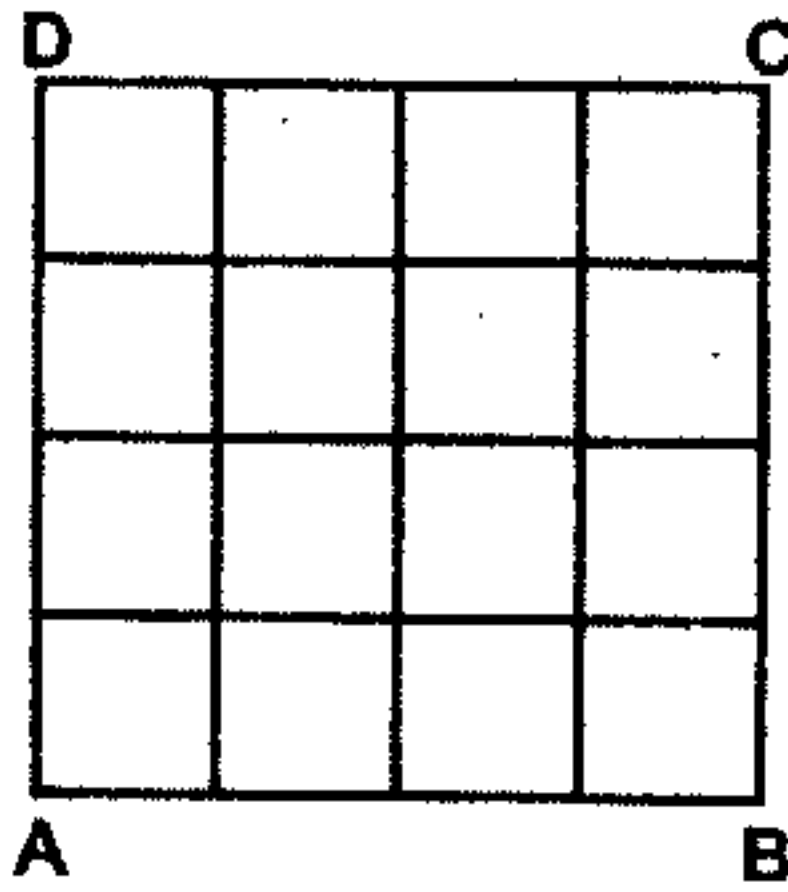
4 سینٹی میٹر

مستطیل میں کل بارہ مربع ہیں لہٰذا مستطیل کا رقبہ 12 مربع سم ہوگا۔

لہٰذا $3+3+3+3 = 4 \times 3 = 12$ سم^2

چنانچہ **مستطیل کا رقبہ = لمبائی x چوڑائی**

مثال ایک مستطیل کا رقبہ معلوم کریں جس کی لمبائی 5 سم اور چوڑائی 3 سم ہو۔

حل مستطیل کا رقبہ = لمبائی x چوڑائی

= 5 سم x 3 سم = 15 سم^2

ABCD ایک مربع ہے جس کے ہر ضلع کی پیائش 4 سم ہے چونکہ مربع کے ہر ضلع کی پیائش برابر ہے۔ ہم اس کو 16 چھوٹے مربعوں میں تقسیم کر سکتے ہیں جس میں ہر مربع کے ضلع کی لمبائی 1 سم ہے۔ لہٰذا مربع ABCD میں افقی قطار میں چار مربع اور ہر کالم میں بھی چار مربع ہیں۔ لہٰذا مربع ABCD کا رقبہ ہوگا :

$4 + 4 + 4 + 4 = 16$ سم^2

یا $4 \times 4 = 16$ سم^2

چنانچہ **مربع کا رقبہ = ضلع x ضلع**

1. مندرجہ ذیل کا رقبہ معلوم کیجیے۔

(i) لمبائی = 6 سم ، چوڑائی = 4 سم
(ii) لمبائی = 80 سم ، چوڑائی = 70 سم
(iii) لمبائی = 5.4 سم ، چوڑائی = 4.5 سم
(iv) لمبائی = 16 سم ، چوڑائی = 8 سم
(v) لمبائی = 9 سم ، چوڑائی = 5.5 سم

2. مندرجہ ذیل مربع کا رقبہ معلوم کیجیے جبکہ ہر ضلع کی لمبائی نیچے دی گئی ہے۔

(i) 6 سم (ii) 30 مم (iii) 6.5 سم (iv) 56 سم

3. رواحہ نے بستر کی چادر خریدی جس کی لمبائی اور چوڑائی دونوں 3 میٹر ہے چادر کا رقبہ معلوم کیجیے۔

4. شاہد اپنے کمرے میں قالین بچھانا چاہتا ہے۔ اس کے کمرے کی لمبائی 4.8 میٹر اور چوڑائی بھی 4.8 میٹر ہے۔
اس کو کتنا قالین چاہیے ہوگا جبکہ وہ دیوار تا دیوار قالین بچھانا چاہتا ہے۔

5. اپنے گھر میں موجود میز کی لمبائی اور چوڑائی ناپیے اور اس کا رقبہ مربع سینٹی میٹر میں ایک درجہ اعشاریہ تک معلوم کریں۔

6. اپنی جماعت کے کمرے کا رقبہ معلوم کیجیے۔

7. کسی مستطیلی میدان کی چوڑائی اس کی لمبائی کا نصف ہے اگر اس کی چوڑائی 7 میٹر ہے تو اس کا رقبہ معلوم کیجیے۔

8. اگر کسی مستطیل کی لمبائی 12 میٹر ہے اگر اس کی لمبائی اس کی چوڑائی سے 2 میٹرز زیادہ ہے تو اس کا رقبہ معلوم کیجیے۔

9. اگر آپ کا پلنگ 2.25 میٹر لمبا اور 2 میٹر چوڑا ہے تو بتایئے اس نے آپ کے کمرے میں کتنا رقبہ گھیرا ہوا ہے ؟

10. آپ کی جماعت میں لگے ہوئے تختہ سیاہ کا رقبہ معلوم کریں۔

Notes to the Facilitator:

To assess participants' level of understanding of this workshop:

- Ask participants to develop a similar demonstration lesson using KWL and Think Aloud strategies using a mathematics topic.
- Share the lesson with a colleague and discuss similarities and differences in their plans.
- Teach the same lesson during the field work and self assess his/her own teaching.

At the end of the session the participants will complete the Debriefing Sheet for the lesson.

Allow time to discuss the participants' questions and comments from the debriefing sheet using the "Think, Pair, Share" method.

- Each participant completes the Debriefing Sheet independently.
- Each participant discusses his or her Debriefing Sheet with a partner.

Partners share their responses to the Debriefing Sheet if they choose. The facilitator should help participants to feel comfortable and should tell them to share only what they want to share, help each other answer questions, and respond to comments from each other and the facilitator.

Reading material on important concepts about making learning of Math enjoyable is given in the additional reading text provided at the end of this module.

DEBRIEFING SHEET FOR DEMONSTRATION

Note: **Please follow the lesson plan and at the end of the lesson, file this debriefing sheet to reflect on your learning.**

Demo Lesson Number ________ Topic __________ Level ________

1. Please list three things you learned from this lesson:

____

____

____

____

____

2. Please list two questions you have after finishing this lesson:

____

____

____

____

____

3. How might you adapt this lesson to fit your classroom context?

____

____

____

____

____

GLOSSARY

Constructivism	A theory of learning that argues that people learn best not when they listen passively to lectures or simply answer questions on readings, but when they are engaged in active learning. Constructivism suggests that students learn best when they can connect new information with their personal lives and experiences, as well as with what they already know (background knowledge); are given opportunities to make sense of new knowledge, information, or skills (construct meaning); and asked to reflect on new information learning and apply it to new situations (evaluate and apply).
Activating background knowledge	First phase of a constructivist framework for learning and teaching in which students are helped to recall what they already know about on a topic under discussion.
Constructing meaning	Second phase of a constructivist framework for learning and teaching in which students are helped to make sense of new information as they learn it.
Evaluating and applying information	Third phase of a constructivist framework for learning and teaching in which students are helped to think about what they have learned, examine, assess and evaluate new information, and/or apply it in new contexts or to new problems, issues, or topics.
Graphic Organizer	A Graphic Organizer is a visual representation of knowledge, concepts, or ideas. They are known to help engage students and relieve boredom; enhance recall of new information, concepts, and ideas; motivate students; clarify information; assist students in organizing their thoughts; and promote deep understanding.
KWL technique	The KWL strategy is a technique that helps students activate what they already know before they begin the lesson ("Know"), think about what they would like to know about a topic under study ("Want to Know") and then reflect on what they have learned after the lesson ("Learned").

Think Aloud	A Think Aloud involves a teacher or student "thinking out loud," talking through his or her ideas as he or she completes a task or solves a problem. This makes one's thinking visible to others so they can share, reflect on, and evaluate the thinking process.
Concept Web	The Concept Web helps students organize ideas and information, and to see similarities and differences between different ideas or different pieces of information. A Concept Web includes a word or phrase in the center with related words arranged around the central word or phrase, connected to it with lines.
Venn Diagram	A Venn Diagram helps students compare and contrast information. It can be used as a prediction technique, as a graphic organizer, or as a means for students to show what they have learned. A basic Venn Diagram has two overlapping circles. Each outside section tells how the two things being compared are different; the similarities are written in the overlapping center of the two circles.
Value-Line	The Value-Line strategy provides a way for students to think about and express opinions about a subject. A Value Line presents opposite responses to a new idea or issue (such as "Agree" and "Disagree" or "Yes" and "No") and asks students to take a stand somewhere between the two extremes.
Anticipation Guides	Anticipation Guides are tools teachers use to activate background knowledge and to engage students' interest by encouraging them to "anticipate" what they will learn in the lesson. There are many kinds of Anticipation Guides, which help students prepare their minds for new ideas and concepts.
Classification	Classification helps students approach new problems and issues. Classification teaches students to use a set of criteria to organize new information, concepts, and ideas.
Inquiry	Inquiry is a strategy in which students conduct independent research about a topic. They may use a variety of sources: the Internet (if available), encyclopedias, books or magazines, or even short pieces of text written by the teacher. Before the students begin their Inquiry, the teacher helps them determine two to four questions that they will

	answer with their research. What is important about Inquiry activities is that the teacher helps students set it up, but then the students do their own investigations while the teacher monitors their progress and offers support as needed.
Jigsaw	A Jigsaw activity is performed with students formed into groups. Questions or topics are posed and each group sets about gathering information on a subset of questions or topics; in this way, each group becomes the "Expert Group" for its subset. Once each group has gathered information, they share their information with the rest of the class. Depending on the classroom context and the teacher's preference, each Expert Group can share its knowledge in a variety of ways.
Think, Pair, Share	Think, Pair, Share is a way for members of a large group to first think independently about an idea, then share with one other person in a quiet conversation, and then hold a large-group discussion. In this way, people can be made comfortable developing their ideas first alone, then with a trusted partner, and finally sharing them with a whole group.

Additional Reading
CAN MATH LEARNING BE MADE ENJOYABLE?

Development of communication skills is necessary, but it is not enough to ensure academic achievement. Learning to interpret bar graphs, for example, requires both communication skills and problem-solving skills.

THE PRESENT state of teaching mathematics in a majority of the schools is far from satisfactory. The rate of failures in mathematics is considerably higher than in other subjects. Many find mathematics a difficult subject. Limited English Proficient (LEP) students are often faced with the challenge of developing oral communication skills and academic skills in English. To succeed in the mainstream classroom, LEP students must learn both academic and communication skills. To develop academic skills, students must receive meaningful, relevant content-area instruction presented in a framework of appropriate English language development skills. There are two approaches for teaching LEP student's to improve their academic skills in mathematics, Cognitively Guided Instruction (CGI) and Active Mathematics Teaching (AMT).

Cognitively guided instruction

Cognitively Guided Instruction (CGI) can be an effective approach for teaching mathematics to LEP students', if it is integrated into the AMT approach or used as a stand-alone method. It focuses on the students' thought processes while solving mathematics problems. It is based on four related the teacher competencies: teachers should know how specific mathematical content (for example, addition and subtraction) is organised in children's minds; Teachers should be able to make solving mathematical problems the content focus and also assess in what way their students are thinking about the content in question.

The teachers should also be able to make instructional decisions (e.g., sequencing of topics) based on their own knowledge of their students' thinking. Teachers can receive training to attain these competencies through a variety of programmes. CGI can be particularly effective for several reasons.

Students receive basic skills instruction in a problem-solving context that is meaningful, fostering higher order thinking skills, and as the students become proficient at problem solving, they develop confidence in their abilities.

Problem solving motivates students to stay on task, since it is cognitively challenging. When using the CGI, teachers and students work through the exercises in the lesson; and the teacher asks the students how they arrived at their answers, that is, the students discuss what strategies they used to answer the questions. The important factor is to learn how the students ascertained their responses. The teacher should explain to them that there are several ways to solve a problem. Thus the students who answered incorrectly will learn how to arrive at the correct answer. This increases self-confidence and the motivation to learn. CGI also can help teachers focus on how their students solve problems. Once the teachers get an idea about their students' methods, this information can be used to individualise the way the teacher approaches the content for different students.

Active mathematics teaching

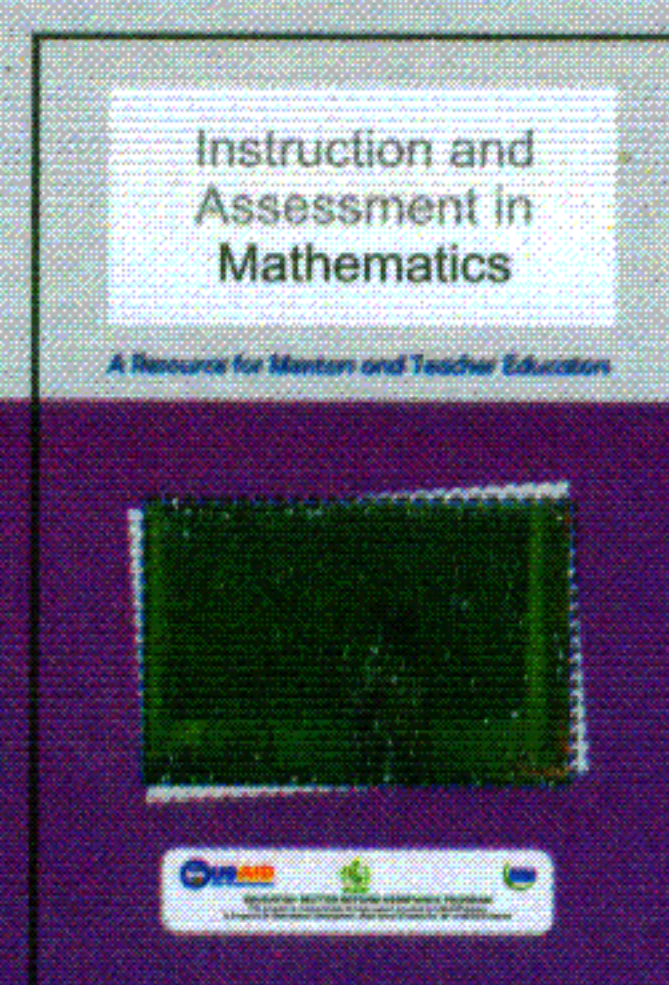
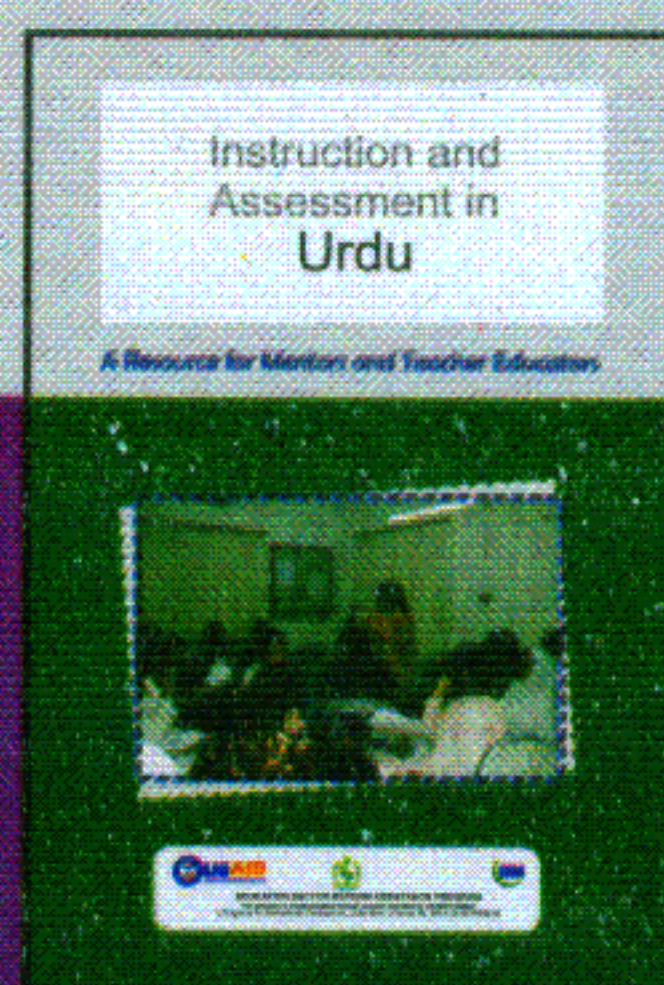
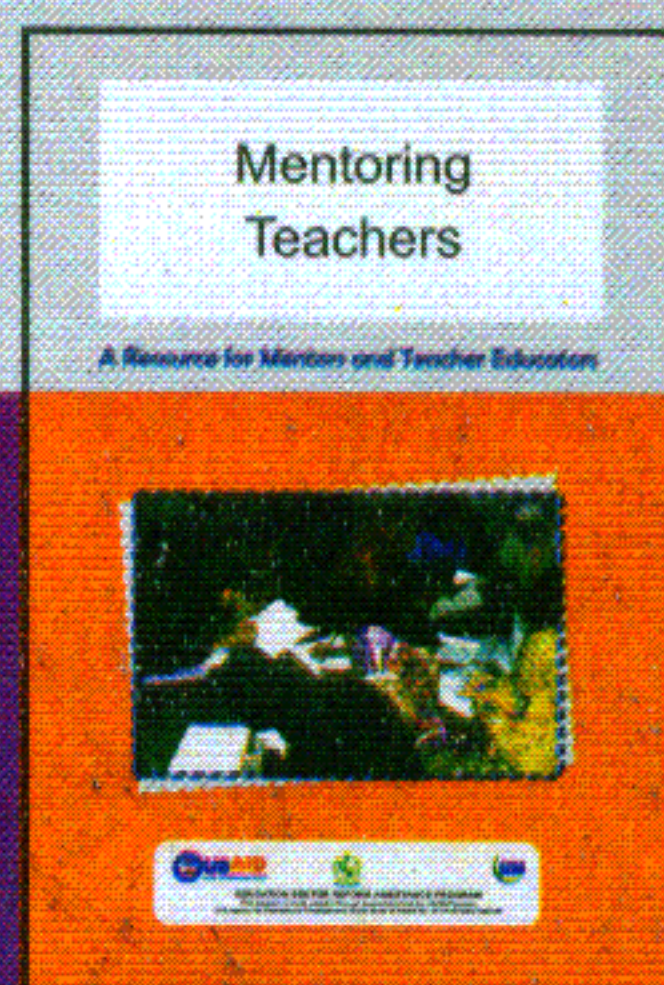
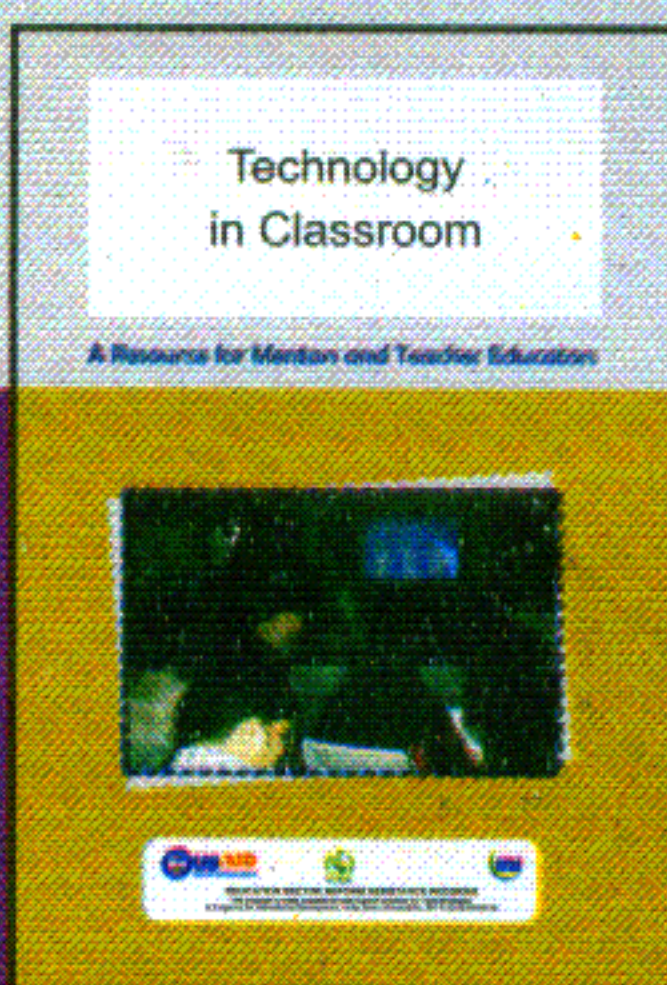
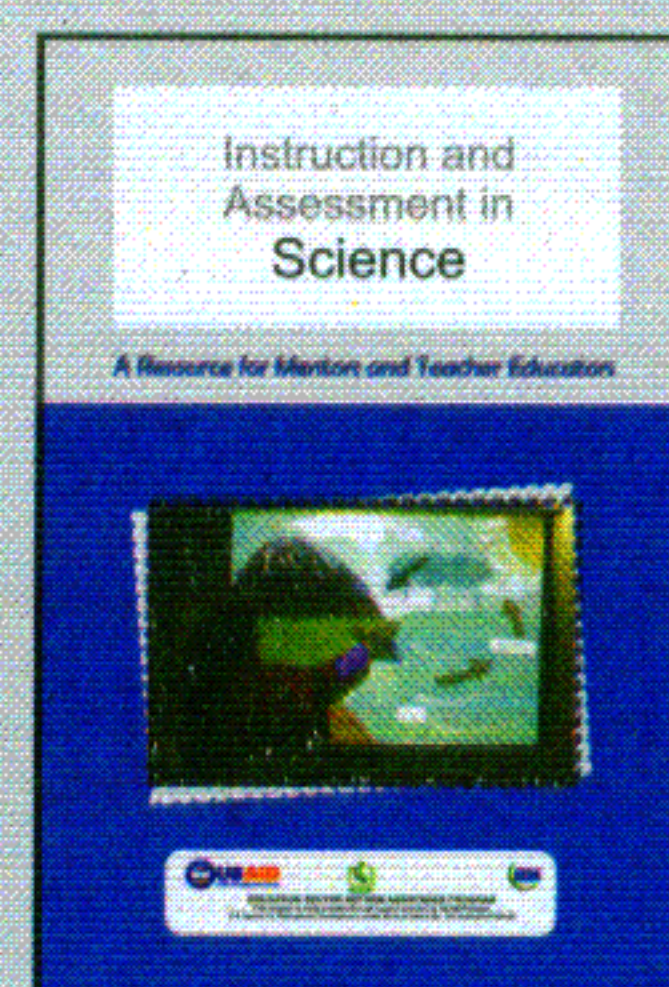
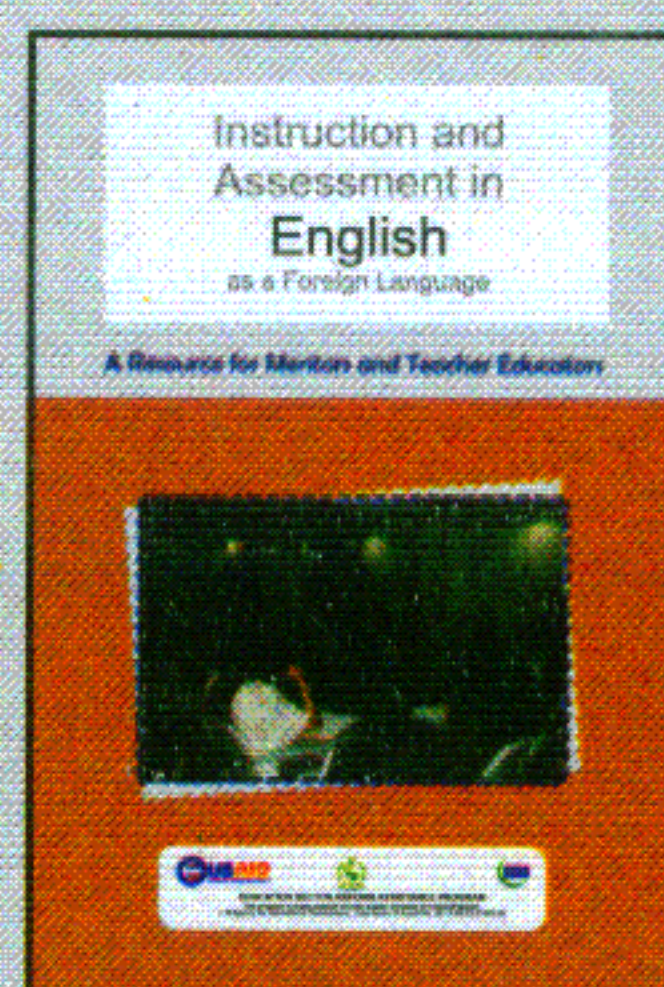
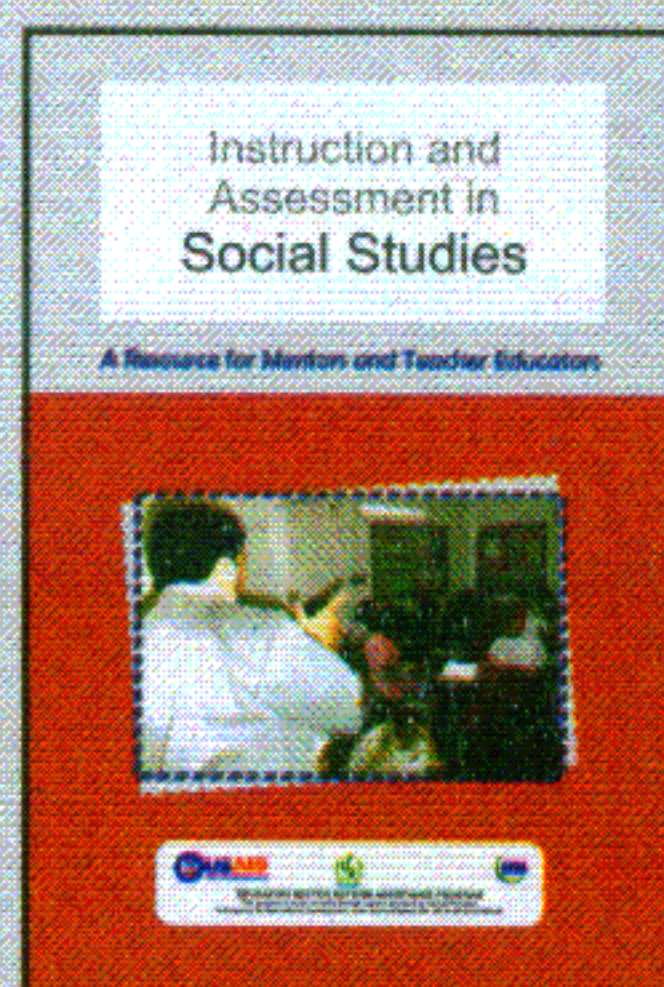
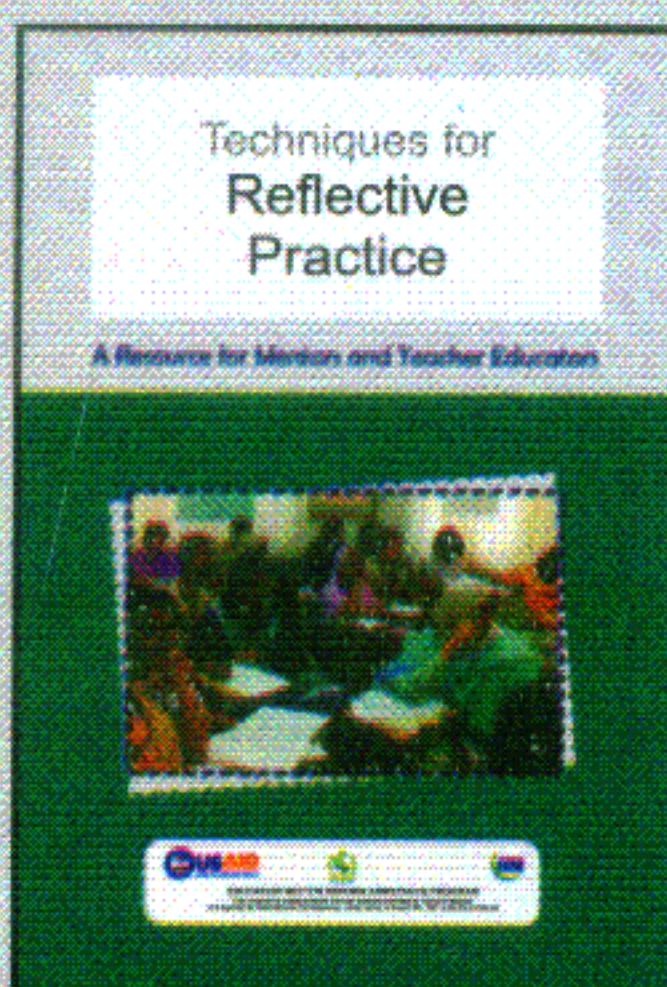
Active Mathematics Teaching (AMT) is a form of instruction, proved effective in teaching large bodies of highly structured materials such as basic mathematics skills. AMT is a structured teaching sequence typically organised into a 45-minute lesson: review (8-10) minutes; develop new content with controlled practice (20-25 minutes); and seatwork and homework (10-15 minutes). This method of organising instruction can also be used effectively with other content areas such as science or social studies. AMT was originally developed for whole class instruction, but it can also be used with small cooperative groups. The following are the three characteristics of AMT, which make it especially suitable for teaching math to LEP students. (i) Since this method is highly organised and structured, the students receive continuous reinforcement with contextual clues about both the content of the material and the structure of the lesson, (ii) During the content development portion of the lesson, the teacher can modify the activities for individual students and (iii) During the seatwork phase, the teacher can work individually with students who need additional instruction.

In the first sequence, ie., review, the teacher starts the lesson by telling the students very clearly what mathematics objectives they will learn that day. The teacher writes the objectives on the board before beginning the lesson. The written objectives can be reinforced with oral repetition also. During the development phase, the teacher should check the pre-requisite skills and concepts, provide process explanations, illustrations, and demonstrations. As a transition to the seatwork portion of the lesson, assess your students' comprehension by having them work at some controlled practice activities that extend the concepts discussed in the lesson. To maintain on-task behaviour, check students after every one or two problems. This reduces the chance of students practicing errors that will have to be corrected later. Controlled practice also provides an easy transition to individual seatwork. The seatwork portion of the lesson should last about 15 minutes. It allows students to successfully practice the concepts and skills introduced in the lesson.

The teacher will be able to identify those students who have difficulty in understanding the lesson. They will require individual attention. The lesson should end with a homework assignment that includes some review problems to maintain skills and some problems that extend the seatwork portion of the lesson. Homework should include more than drill and practice. It can supplement seatwork and can become the content for the next day's review.

The NCERT, at the national level, and SCERT/SIEs at the State level have initiated several steps to improve the quality of mathematics education in our schools. The Association of Mathematics Teachers of India is doing very useful work in this regard. Nevertheless, ultimately it is with the classroom mathematics teacher that everything depends. Every teacher can do a lot in his/her own way, to make the learning of mathematics more enjoyable, leading to the qualitative improvement of mathematics education in our schools.

Source:

Shaljan, M. Can Math learning be made enjoyable? The Hindu Education June 11 2002 [online: http://www.hindu.com/thehindu/edu/2002/06/11/stories/2002061100040200.htm]

This manual is part of a series of eight manuals, developed to enhance the professional capacity of mentors and teacher educators. The series has been written by a team of national and international experts working in various public and private sector institutions. These manuals have been developed by the Professional Development Component of USAID/ESRA.

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Education Sector Reform Assistance (ESRA) is a US$ 83 million U.S. Agency for International Development (USAID) funded program that supports the Government of Pakistan's (GOP) Education Sector Reforms initiative. The program's objective is to provide the knowledge, training, and infrastructure necessary to help officials and concerned stakeholders develop high quality education programs for girls and boys in target areas in Pakistan. Operating under a bilateral agreement between the Governments of Pakistan and the United States of America, USAID/ESRA is organized through national and international partners, led by Research Triangle Institute International, North Carolina, USA.

The program supports five of the seven principal ESR objectives outlined in the GOP's strategy. These components are Policy and Planning, Professional Development of Teachers and Education Managers, Youth and Adult Literacy, Public Community-Public Private Partnerships, and ESRA Plus (Information and Communication Technology in Education). Each component focuses on providing service delivery for capacity building, educational services, strengthening of systems at local, district, provincial, and federal levels and recommending policies to the government to embed reforms within the system. All interventions are collectively reinforcing and eventually converge on school improvement in twelve districts of Sindh and Balochistan provinces of Pakistan as well as in the Islamabad Capital Territories.

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